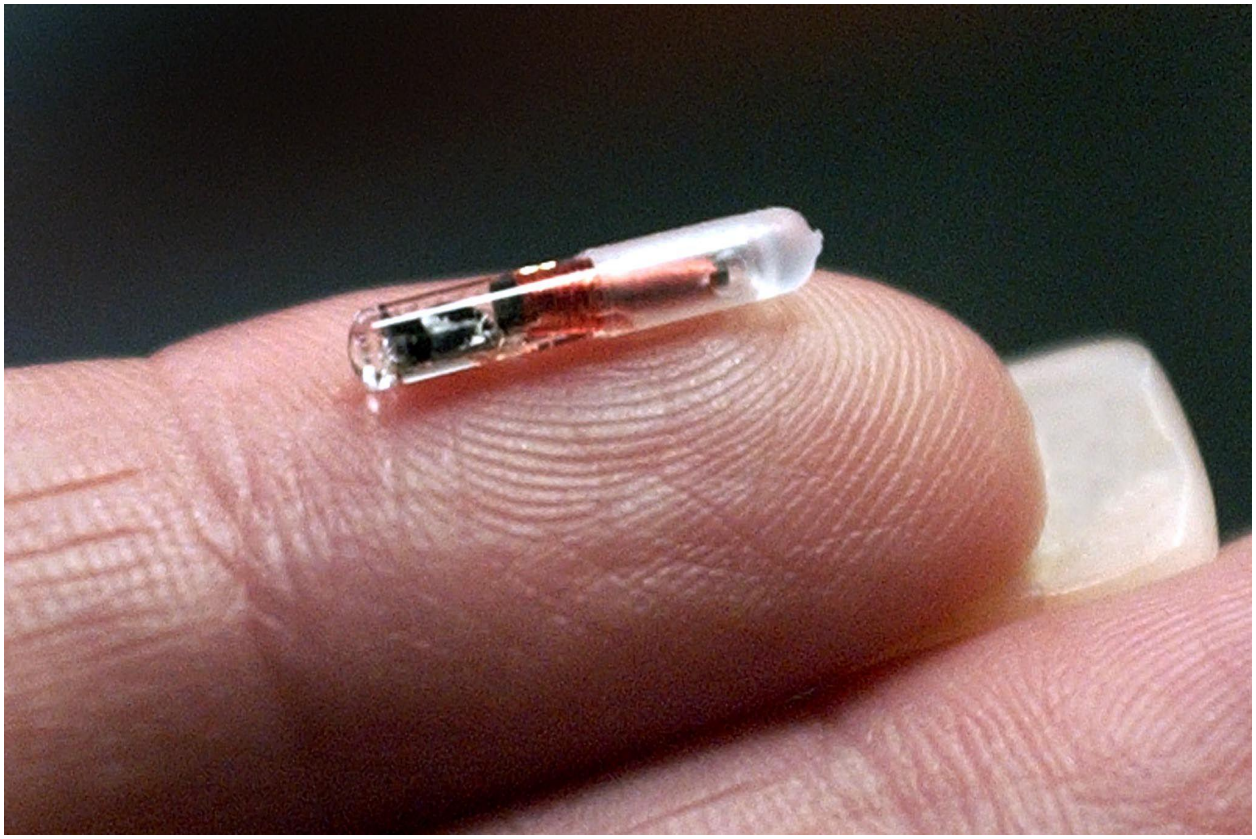

Generating Consistent Professional Reports

Group 8

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***for use in* CS 440**
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I Project Description

1 Project Overview

With farming becoming more and more complicated, the Livestock Management System aims to provide livestock farmers and ranchers a more effective and efficient way to manage their livestock through Radio Frequency Identification (RFID) technology. LiveStock Management System provides tools and resources to help track and manage the health, breeding, population, and production of livestock in a comprehensive and user friendly interface.

2 The Purpose of the Project

A livestock management application is made to enhance decision-making, improve effectiveness, accuracy, and effectiveness of livestock management practices by streamlining procedures, enhancing accuracy through real-time data and automated processes, enhancing profitability, and ensuring regulatory compliance. The use of this technology enables farmers to run a more sustainable and lucrative business by enabling closer monitoring of the health, nutrition, and behavior of the animals, providing instant insights and alerts, automating manual processes, and decreasing the possibility of record-keeping errors.

2a The User Business or Background of the Project Effort

Content:

The livestock farming business can provide a steady source of income for a farm business. However, it requires careful planning and management to ensure that the animals are healthy and productive, and to minimize costs and maximize profits.

Motivation:

Raising animals requires attention in several areas such as breeding, nutrition, health care, record-keeping and marketing. A farm with a large number of animals makes it difficult to track all of the above attributes, so a technology to store and manage all of this data will be of great benefit to farmers.

2b Goals of the Project

Content:

The application is meant to provide proper care, nutrition, and a healthy environment to livestocks as well as contributing the best quality of product for farmers, and the efficient way for them to give their animals a standard habitat.

Motivation:

The goals of the livestock management system are influenced by a combination of ethical, practical, and legal factors. Farmers must offer humane care and treatment for their animals. It is believed that there is an ethical duty to ensure the wellbeing of animals and to improve their health and well-being. The economic component would increase the production and effectiveness of an animal farm, boosting its profitability and sustainability. It might also ensure the security of the food supply and the welfare of animals.

Examples:

We want to provide adequate living conditions, such as housing, space, and access to natural light, which is important for promoting the welfare of the animals. Maximizing the productivity and efficiency of the farm is a key goal of animal farm management.

2c Measurement

The goal of the Livestock Management System can be measured in many factors to determine if they have been met, like maintaining animal health since it monitors whether the animal in the farm has received any special treatments and vaccinations. It can observe the growth and reproductive rates of the animals, as well as the efficiency or profitability of the farm which maximize the productivity to meet the requirements. The other success of this goal will be measured by labeling the production date and its quality to make sure that all goods from the cattle have a low incidence of foodborne illness to meet the food safety regulation.

The measurable results can be used to assess the success of various goals of animal farm management could include the immunization improvement, animal behavior improvement, reproductive performance increasement and especially, the efficiency and profitability of the whole farm.

3 The Scope of the Work

In order to successfully manage a herd of animals, a variety of procedures and factors under livestock management must be taken into account. These include providing appropriate and comfortable housing, planning and managing breeding programs, developing and implementing feeding programs, managing the environment to ensure cleanliness and safety, maintaining thorough records of the animals as well as the farm operations and finances, and ensuring compliance with pertinent laws and regulations such as food safety.

3a The Current Situation

Historically, manual procedures and methods have been used to maintain cattle.

Logbooks and other paper-based techniques were often used to keep records, and the information was frequently kept in actual file cabinets. Even while this way of managing cattle is still successful today, it can be time-consuming and prone to mistakes.

Many livestock managers are increasingly using computer-based solutions to assist them streamline their procedures and increase the accuracy and efficiency of their job as a result of the development of technology. These systems frequently incorporate software applications and mobile apps that support managers in monitoring the well-being, diet, and behavior of the animals as well as the farm's finances and daily operations. Managers may swiftly and easily make educated decisions with the help of these technologies, which frequently employ real-time data to deliver rapid insights and warnings. Additionally, computer-based systems can store a lot of information and automate a lot of the labor-intensive procedures associated with managing cattle, which can assist to lower the possibility of mistakes and boost overall productivity.

3b The Context of the Work

3c Work Partitioning

Event name	Input	Output
Animal Tag fair	Software reading	Animal ID Number
Farm Tracking	Animal ID number	Animal location. Notify the user when the animal is out of scope.
Animal Health Tracker	Animal ID number	Animal daily health report. See if they need medical treatment.
Animal Weight Tracker	Animal ID number	Animal Weight overtime and their ideal weight
Animal Breeding Fair	Animal Id,location and gender	Best season for breading and select the best ID to breed.
Animal ID	None	Animal ID Number and location
Animal Management	Animal ID number	Animal location and whether the are sold or not .
Feeding Monitor	Animal ID number and the amount of food they eat	Animal Weight overtime and how much they should be fed.
Animal Environment tracker	Animal ID and location	Keep track of the animal location and their environment temperature to provide ideal place for living.
Animal Life tracker	Animal ID number	Notify business about the life expectancy of animal, the death of animal and the cause of it.

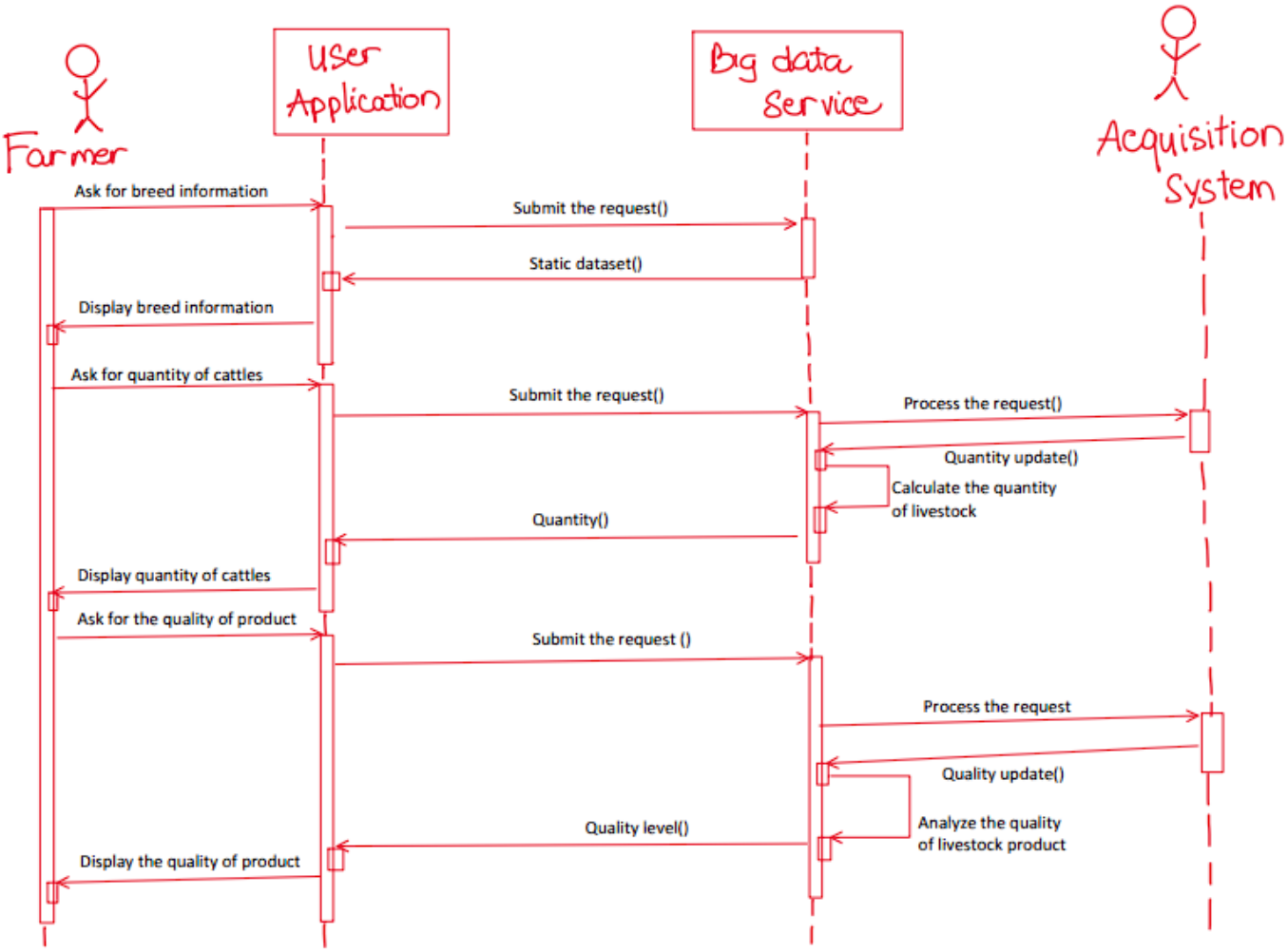
3d Competing Products

Even if there are other items on the market, the proposed product is still necessary since it stands out from the crowd because of its distinctive features and advantages. The proposed product, for instance, might contain increased accuracy and efficiency features that enable more precise and effective record keeping. In order to meet the unique demands of the customer, it might also offer customization possibilities. Additionally, the suggested solution might feature an intuitive user interface and a mobile platform that is easy to use, which would make it simpler for the client to manage their livestock operation. These elements working together can produce a more efficient and successful livestock management process, which in turn can increase customer production and profitability.

4 The Scope of the Product

The Livestock Management System is what is being proposed, and it tries to streamline and automate these procedures. A portion of the work linked to managing cattle will be handled by the system, and this portion will be described in the introductory paragraph. Short stories or scenarios that illustrate how the system will be used in practice will be used to present the product. This will efficiently list what is and is not included in the product, as well as who or what will use it and how.

4a Scenario Diagram(s)


Farmer
User Application
Big data Service
Acquisition System
Ask for breed information
Submit the request()
Static dataset()
Display breed information
Ask for quantity of cattles
Submit the request()
Process the request()
Quantity update()
Calculate the quantity of livestock
Quantity()
Display quantity of cattles
Ask for the quality of product
Submit the request ()
Process the request
Quality update()
Analyze the quality of livestock product
Quality level()
Display the quality of product

4b Product Scenario List

Scenario Name	External Actors Involved	Information
Disease Surveillance	Livestock Manager, data Analyst, Health specialist	Monitors for animal diseases and the disease rate of animal
Production Tracking	Livestock Manager Data Analyst	Tracks the production of animals such as milk
Waste Tracking	Livestock Manager	Tracks the animal waste for production such as fertilizer
Feed monitor	Livestock Manager	Monitors the amount of food for animal
Breeding monitor	Livestock Manager,data Analyst, breeding specialist	Control and manage the breeding of each type of animal
Health Tracking	Farm animal health specialist, livestock Manager	Analyze and track the health issue of animal
Location Tracking	Livestock Manager	Track the location of animal
Noundeath	Livestock Manager, data Analyst, breeding specialist	Track the death rate of animal at specific condition
Identity	Livestock Manager	Track and verify animal identity
Sale Tracking	Livestock Manager, Buyer	Track if animal is sold legally or the sales come from the product of that animal

4c Individual Product Scenarios

One scenario may describe a user, John, who has been running his livestock farm using conventional ways for many years. John, however, made the decision to move to a livestock management system due to the growing number of animals and the

requirement for more effective record keeping. John is able to monitor all of his animals' health, feed intake, and growth rates in real-time thanks to the technology. He may simply produce reports on his animals and monitor their development over the course of the year. John no longer had to rely on manual record keeping, which was time-consuming and prone to errors. John can now concentrate on providing better care for his animals and boosting productivity thanks to the livestock management system.

5 Stakeholders

Depending on the operation's scale and complexity, different stakeholders may be involved. Farmers and ranchers, who are in charge of the daily upkeep and management of the animals, are the main users. The program allows veterinarians to keep an eye on the health of the animals and offer guidance on their care and treatment. Agents for agricultural extension can help and advise farmers and ranchers. Furthermore, the program is used by regulatory organizations to check for compliance with laws governing animal care and to keep track of the population's health. Suppliers of livestock can oversee their own businesses and make sure their customers are getting animals of the highest caliber. Buyers of livestock can evaluate the animals being sold for their quality and health and then make an educated selection. Financial institutions are able to evaluate the operation's financial situation and offer assistance and funding.

5a The Client

The Animal Farm System is an idea by the RRVA Development Group. The system is being developed for the purpose of making livestock farming more efficient. The target buyers are farmers and ranchers that wish to modernize their and harness the full potential of their livestock

5b The Customer

Those who are in charge of taking care of and managing a herd of animals, such as farmers, ranchers, and other livestock producers, can be the target market for a livestock management application. Both large-scale businesses and more modest, family-run farms may fall under this category. Depending on the size and requirements of the operation, either a single person managing a small herd of animals or a huge enterprise with thousands of animals may use the program.

Customers use livestock management applications primarily to increase the precision, efficacy, and efficiency of their own livestock management procedures. Customers may make informed decisions based on real-time data, streamline manual operations, and lower the risk of record-keeping errors by using this technology. By offering immediate insights into the health, diet, and behavior of the animals, the program can also aid in improving animal health

and welfare by allowing for the quicker and more efficient identification of any problems. By assisting farmers in running a more sustainable and effective company and by providing accurate and thorough records of animal health, nutrition, and behavior, the usage of a livestock management program can also boost profitability and assure compliance with regulations. Customers can manage their livestock operations in a complete way by using a livestock management tool, which can lead to better outcomes for both the animals and the company.

5c Hands-On Users of the Product

Farm Owner/Owners:

Individuals who are the owners of the farm using the system that are typically responsible for the day to day operations of the farm and/or ranch. This task includes but is not limited to the buying and selling livestock,the maintenance of the farm/ ranch, control of the finances. They will be responsible for reading reports generated by the software and acting accordingly based on the results of the report. They would typically be extremely knowledgeable in the field of farming and ranching but based on experience can range from novice to expert. Their technological experience can vary vastly depending on a wide variety of variables; some may have already adopted technology in other parts of their farm and can be considered masters in technology while others can be hesitant to adopt technology and can be considered a novice in the field.

Farm Workers:

Workers will be responsible for implanting the tag on the animal,it is assumed that workers are already proficient in this task. They will be entering data that will be stored in the RFID that will later be used in the software to build reports. Farm workers are responsible for most physical tasks on farms and ranches.For those workers that could potentially struggle with the entering of data a comprehensive user friendly description will be provided on how to enter data. Farm and ranch experience can vary vastly from worker to worker therefore there will be a mix of individuals that are novices and experts in the field. For the most part in the modern age most people have a basic understanding of technology and how to use it can be assumed that most farm workers will rank in the intermediate level for experience with technology. It must be noted that there is a high possibility that workers on farms come from a background where English is not their first language and can possibly not speak or understand the language.

5d Maintenance Users and Service Technicians

Users with technical backgrounds or IT specialists are the ones who will be in charge of installing, maintaining, upgrading, and supporting the livestock management

application. They will make sure the product is set up and configured correctly, and that it keeps working as it should over time. This could entail fixing problems as they happen, updating software, and making sure the application is still compatible with other platforms and tools. These people will be instrumental in making it possible for the end-users to have a dependable, stable, and efficient tool for managing their livestock operations.

5e Other Stakeholders

Government Agencies

Even though the system is primarily designed to be used by farmers on their personal farm, it could be adopted by government agencies, such as the United States Department of Agriculture, as a way to monitor the livestock industry to ensure that all laws and regulations are being followed by all farmers and ranchers.

Food Industry

With the increase in efficiency on farms there is a possibility that fewer workers will be needed for the day to day operations of farms. This could result in workers looking for work elsewhere; they could end up going to other agricultural and food industries bolstering the workforce..

1) Sponsor

· Role: The project's funding is provided by this individual or group. They could be a person or a business.

· Knowledge requirement: knowing the project's goals and spending plan.

· Involvement: High.

· Influence: High.

· Agreement on addressing conflicts: Priorities and goals of the sponsor should be taken into account and matched with those of the project.

2) Volunteer testers

· Role: These are the people who will test the software to make sure it complies with the necessary requirements.

- Knowledge requirement: prior knowledge of the testing procedures and software.
- Involvement: Medium to high.
- Influence: Medium
- Agreement on addressing conflicts: All parties participating in the testing process should specify and agree upon the testing requirements.

3) Business analysts

- Role: These people examine the project's business requirements and make sure the software satisfies with these.
- Knowledge requirement: knowledge of the business needs and the target audience
- Involvement: High
- Influence: High
- Agreement on addressing conflicts: All parties involved in the business should establish and agree upon the business requirements.

4) Data experts

- Role: These people are skilled at managing and analyzing data, including information gleaned via RFID ear tags.
- Knowledge requirement: skills of managing and analyzing data
- Involvement: High
- Influence: High
- Agreement on addressing conflicts: All parties involved should formally specify and concur upon the needs for data management and analysis.

5) Representatives of outside organizations

- Role: These people speak for associations that have a stake in the software, like those that advocate for animal welfare or agriculture.

· Knowledge requirement: knowledge of the issues and requirements of their particular organizations.

· Involvement: Medium to high.

· Influence: Medium to high.

· Agreement on addressing conflicts: All parties concerned should establish and agree upon the needs and concerns of the various organizations represented.

6) Technical support

· Role: These people assist software users by assisting them with any technical problems they may experience.

· Knowledge requirement: knowledge of the technical support and software processes.

· Involvement: Medium to high.

· Influence: Medium.

· Agreement on addressing conflicts: All key stakeholders should establish and agree upon the technical support requirements.

7) Marketing experts

· Role: These people create the software product's marketing plans.

· Knowledge requirement: knowledge of marketing tactics and the target market.

· Involvement: High

· Influence: High

· Agreement on addressing conflicts: All potential buyers should agree on a clear definition of the marketing plan.

8) Legal experts

· Role: These people offer guidance on the software product's legal needs, such as data protection laws.

· Knowledge requirement: knowledge of law and the copyright of the target market.

· Involvement: Medium

· Influence: Medium

· Agreement on addressing conflicts: All parties should be distinctly stated and accepted by the law.

5f Priorities Assigned to Users

Depending on the particular demands and goals of the project, the level of user involvement throughout the creation of the RFID ear tag software for animals would vary. The software's intended users, such as animal producers or veterinarians, should ideally be involved in all stages of development to provide feedback on their needs and specifications. This can involve imparting business expertise, testing the software and offering usability input, and helping to develop the product's interface and features.

Users will need to spend a minimum of 10 to 20 minutes providing input on the needs, depending on the person. We will make sure all users have the tools and time they need to offer useful feedback all along the development process. This can assist guarantee the project's success and that the software will fulfill the needs of its target audience.

To make sure that users' suggestions and feedback are properly included into the development process, it is also critical to establish open channels of contact between the development team and users. This can assist in resolving possible conflicts between stakeholders and ensuring that everyone is in agreement with the project's objectives and specifications.

6 Mandated Constraints

6a Solution Constraints

+Description: The product must be able to withstand and continue to function under a wide range of weather conditions.

Rationale: Different livestock require different environments to raise, some livestock are kept outside at all times.

Fit criterion: All tags produced will be encased in a shell that will be able to withstand a wide range of weather conditions.

+Description: The product will be shock resistant.

Rationale: Livestock engage in a variety of physical activities if the product is not shock resistant then it can become damaged making reading data from it impossible.

Fit criterion: The housing of the RFID will be shock resistant.

+Description: The product will store data both on physical hardware and cloud storage.

Rationale: Farms tend to be in more rural locations where internet and power outages can be common.

Fit criterion: The data will be backed up to the cloud in case data on the user side is lost or corrupted.

+Description: With a minimum read range of 10 cm, the program must be able to read and write RFID tags.

Reason: To ensure effectiveness in the field, the customer requires the program to be able to read and write RFID tags from a distance.

Fit criterion: The software must have a high level of accuracy and be able to read and write RFID tags within the designated read range.

+Description: The client should receive value for their money from the program.

Rationale: Because the client's project budget is constrained, it's critical to make sure the software offers good value for money.

Fit criterion: To make sure the software offers good value for money, it should be assessed for cost-effectiveness and compared to competing products on the market.

+Description:Compatible with current RFID ear tag hardware: The software shouldn't need any further hardware investments and should work with the present RFID ear tag hardware.

Rationale: The client may not be able to afford the cost of changing the hardware given their limited project budget.

Fit criterion: To ensure adequate functioning and compatibility, the software should be validated with the hardware that is currently in use.

+Description: Farmers, ranchers, and other stakeholders should be able to easily understand and operate the software's user-friendly interface.

Justification: Because the software will be utilized by non-technical users who are unfamiliar with intricate software systems, it needs to be simple for them to operate.

Fit Criterion: To make sure the user interface is friendly and fits the needs of the stakeholders, the program should go through usability testing with real users.

6b Implementation Environment of the Current System

• Hardware: A computer or mobile device, such as a laptop or tablet, will probably execute the program. The precise software requirements, such as memory and processing power, will determine the hardware requirements for the device.

• System: It's possible that the software will function on a popular operating system like Windows, MacOS, or Linux. It will be necessary to choose an operating system based on the target audience and their preferred devices.

• Connectivity: In order to gather and process data from the ear tags, the software will need to communicate with RFID scanners. This might entail wireless communication using Bluetooth or Wi-Fi technology. The precise communication needs will depend on the range and dependability required for the software's intended use.To gather and analyze data from the ear tags, the program could also have to communicate with other gadgets like barcode scanners or GPS systems.

6c Partner or Collaborative Applications

• The ability to combine the RFID ear tag software with any current client or customer software systems, such as livestock management software, if necessary.

• Connectivity with additional hardware components used in the livestock management system, such as RFID readers.

• Adherence to industry procedures and standards for data transfer across systems using RFID ear tags and other technologies.

• Compliance with rules governing data privacy and security, particularly when it comes to private data like cattle health records.

• The client's or customers' operating system compatibility.

6d Off-the-Shelf Software

Spreadsheet software Excel is extensively used and well-liked and offers strong features for data analysis, visualization, and reporting. Excel is widely used by organizations to manage and analyze their data because of this the software will contain the option to export data reports as Microsoft Excel files that can later be viewed in Excel. This will require a trial version of Microsoft Excel to be included in the final project to allow the end user to decide whether or not they wish to continue exporting files as Excel files.

6e Anticipated Workplace Environment

1. Because the workplace is located on a farm, the software must be able to operate in potentially harsh outside settings.

2. Because the job entails handling live animals, the program must be easy to operate while wearing gloves.

3. The program must be able to operate offline and sync data when a connection is available because the workplace has spotty Internet connectivity.

4. Users at different levels of technological proficiency must be accommodated by the software's user-friendly interfaces.

5. The software must be able to effectively process and arrange vast amounts of data because the job entails tracking large herds of animals.

6. The software must be compliant with regulatory standards and be able to provide the necessary reports because the workplace is subject to rules surrounding the tracking and identification of animals.

7. The software must be designed to operate in various weather conditions, with displays that are visible in sunlight, and be rugged enough to withstand wear and tear.

8. The RFID tags are being applied in a way that is uncomfortable for the animals.

6f Schedule Constraints

• The introduction of a new livestock management program, a key element of which is the animal RFID ear tag software.

• A deadline established by the government for the tracking and identification of cattle.

• The beginning of an animal species' reproductive season, when population management and surveillance using RFID ear tag software are essential.

• The start of a trade fair when prospective buyers will see the program in action.

• The organization wishes to fully install the RFID ear tag software by the end of the fiscal year in order to report on the number of animals tagged.

• The establishment of a new facility for animal husbandry that calls for the installation of a tracking system.

• Seasonal variations and peak times for livestock production.

• Certification requirements or laws that must be followed.

• The availability of the implementation-related documents and resources.

• Contractual arrangements with clients or vendors.

• Deadlines for compliance with legal requirements.

• Developments in technology and the accessibility of new tools or equipment that could have an impact on the project.

6g Budget Constraints

1. Human availability: The quantity of people who are available to work on the project and their level of experience may have an impact on the project's budget and resource needs.

2. Equipment and facilities: The budget and available resources may be impacted by the amount of equipment and facilities required for the project as well as their cost.

3. Due to time: Especially if the project needs to be finished quickly, the money and resources needed may change depending on the amount of time available.

4. Dependencies on third parties: Any reliance on goods or services from third parties may have an impact on the project's budget and resource requirements.

5. Regulations requirements: The budget and resources needed for the project may change if there are any legal or regulatory requirements that must be satisfied.

7 Naming Conventions and Definitions

7a Definitions of Key Terms

"Health": Refers to the animal's overall physical condition; this includes weight, temperature, and any current health complications could all be included in this. A list of any medications or treatments the animal has received may also be included.

“Ear Tag”: A small electronic device known as an animal tag is affixed to an animal's body, typically on the neck or ear. The tag has an antenna that facilitates communication with an RFID reader in addition to a microchip that saves data.

“Livestock”: Refers to any animal that has been tagged and has its identification and information logged into the software. Animals include but are not limited to cows, pigs, sheep, and goats.

7b UML and Other Notation Used in This Document

Diagrams were created using the Unified Modeling Language(UML). UML is the standard for visual modeling language used in software engineering. UML provides a way to express software design in a consistent and standardized way that can be understood by developers and stakeholders throughout the software development industry. UML uses use case diagrams, class diagrams, activity diagrams, sequence diagrams, state machine diagrams. Each form of diagram is intended to illustrate a distinct feature of a system, such as the functionality, the structure, the behavior, and the interactions between the system's components. UML is a versatile and potent language that may be utilized in a variety of software situations. Its use in the software industry has made it an important tool for enhancing collaboration, boosting productivity, and lowering the possibility of mistakes during the design and development of software and systems.

7c Data Dictionary for Any Included Models

Farm:

- farmID: Unique identification number of the farm.
- Size: The amount of animals that are on the farm or property.
- Herd: an array of LiveStock that contains all animals on the farm.

LiveStock:

- ID: A unique string that can contain a combination of letters and numbers that identifies the animal the tag is associated with.(This value cannot be changed to help prevent fraud)
- Weight: an int value that contains the weight of the animal.
- Cost: The amount of money the animal was purchased for
- Breeding and Reproduction: Breeding and reproduction data, including tracking mating cycles, pregnancy, and offspring.
- Health Object: An object that contains the health of the animal
- Production Object: An object that contains the production of the animal.(If the animal produces a product)

Health:

- String generalHealth: A description of the animal's current health and any potential health issues.

- String Medication: A description of any medication that the animal is taking

Production:

- int productionAmount: The amount of product the animal produced.
- String productionQuality: The quality of the product.

Data File Formats(ways reports can be exported):

- .txt (text file)
- .docx (Microsoft Word document)
- .pdf (Portable Document Format)
- .jpg (JPEG image)
- .png (Portable Network Graphics image)
- .gif (Graphics Interchange Format image)
- .xlsx (Microsoft Excel spreadsheet

8 Relevant Facts and Assumptions

8a Facts

According to the United States Department of Agriculture of the roughly 2 million farms in the United States 98% of all farms are family owned farms. Smaller family farms do not typically have the same amount of liquid capital that bigger farms have. Most small farms have a profit margin of 20% therefore anything that can make their farms more efficient and profitable would be appealing to small scale farmers. With the amount of farms and the rise of technology and the growing demand for convenient, mobile-friendly solutions, an animal management system would likely be attractive to a wide range of farmers and ranchers who wish to optimize their farm and productivity.

8b Assumptions

Assumption about animal size: Not all animal will have the same ear size (and some might don't have ear due to environment factor)

The software will work on all existing animal. User will need some pre work to transfer or make the device compatible.

The tag will compatible with most type of scanner

The environment where the animal lives will not affect the performance of the software.

The software will track the animal even when they are outside of the farm for legal issues or will not track the animal if user set up the scope or after a legal sale.

The software will meet all the animal tracking regulations and legal requirements before release.

The software will be distributed as beta for bug fix before the official release.

Users already had basic knowledge of how to use device such as computer, smartphone, scanner device ,.. etc. Users also understand the basic of animal tagging method.

The software will not provide private information or violate users privacy without user's permission.

Target of users will mainly be farmer .

The software can import or export a list of prior data base from users. The file formal will vary from txt to microsoft excel.

If the animal tag are properly placed without any damage then there will not be any issue that affect the software performance.

The software will be able to handle certain type of traffic signal in extreme weather condition.

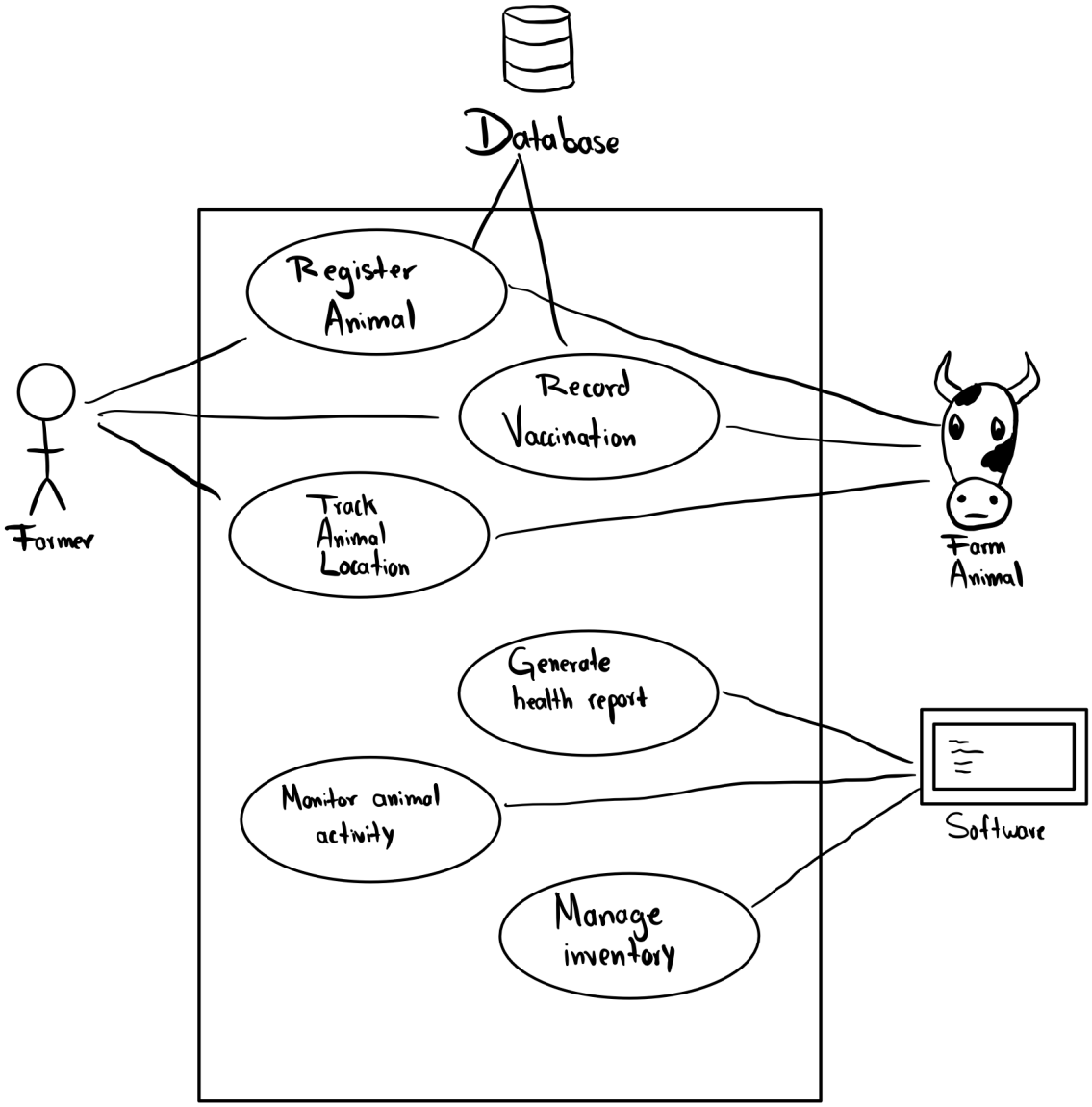
Assumption about new product: There will be similar product release in the purpose of competition.Therefore, the software will constantly update to meet users requirement.

New technology will be developed during the stage of software development as well.

II Requirements

9 Product Use Cases

9a Use Case Diagrams



9b Product Use Case List

+Register animal: This use case involves registering a new animal in the system by inputting its unique identifier and relevant information such as

breed, age, and gender.

+Record vaccination: This use case involves recording the vaccination history of an animal by inputting the date, type of vaccine, and dosage.

+Track animal location: This use case involves tracking the location of an animal by scanning its RFID ear tag and updating its location in the system.

+Generate health report: This use case involves generating a health report for an animal based on its vaccination history and other relevant health information.

+Monitor animal activity: This use case involves monitoring the activity of an animal by tracking its movement patterns and generating alerts for abnormal behavior.

+Manage inventory: This use case involves managing the inventory of RFID ear tags by tracking the number of tags in stock and ordering more as needed.

+Generate performance report: This use case involves generating a performance report for an animal based on its growth rate and other relevant factors.

+Manage user accounts: This use case involves managing user accounts and permissions for accessing the system.

+Export data: This use case involves exporting data from the system for analysis or use in other applications.

9c Individual Product Use Cases

For livestock producers and ranchers to successfully and efficiently manage their animals, the Livestock Management System offers a comprehensive and user-friendly interface. Farmers may enhance herd health, breeding, population, production, and inventory management by utilizing a variety of use cases provided by the system's RFID technology.

Use case ID: Who001

Name: Search for products

Pre-conditions: User is logged in and on the home page

Post-conditions: List of relevant products is displayed

Initiated by: User

Triggering Event: User types in a search query and hits enter

Additional Actors: None

Sequence of Events:

1.User types in a search query and hits enter

2.System searches the database for products that match the query

3.System displays a list of relevant products

=>Alternatives: None

=>Exceptions: None

Use case ID: Who002

Name: Add product to cart

Pre-conditions: User is logged in and on the product page

Post-conditions: Product is added to the user's cart

Initiated by: User

Triggering Event: User clicks on the "Add to Cart" button

Additional Actors: None

Sequence of Events:

1.User clicks on the "Add to Cart" button

2.System adds the product to the user's cart

3.System displays a confirmation message

=>Alternatives: None

=>Exceptions: None

Use case ID: Who003

Name: Checkout

Pre-conditions: User is logged in and has added products to the cart

Post-conditions: User has completed the checkout process and received confirmation

Initiated by: User

Triggering Event: User clicks on the "Checkout" button

Additional Actors: Payment gateway

Sequence of Events:

1.User clicks on the "Checkout" button

2.System displays the cart and prompts the user to confirm

3.User confirms the cart and clicks on the "Proceed to Payment" button

4.System redirects the user to the payment gateway

5.User enters payment information and completes the payment

6.Payment gateway sends a confirmation to the system

7.System displays a confirmation message to the user

=>Alternatives: None

=>Exceptions: Payment is declined by the payment gateway.

Use case ID: SCAN001

Name: Scan and Add Animal Information

Pre-conditions: The system is operational and the user has access to the scanning function and animal information database.

Post-conditions: The animal information is successfully added to the database.

Initiated by: User

Triggering Event: User selects the "Scan" function from the main menu.

Additional Actors: None

Sequence of Events:

1. User selects the "Scan" function from the main menu.
2. System prompts the user to scan the animal's microchip.
3. User scans the microchip with the scanner.
4. System displays the animal's basic information, such as name, breed, and age, and prompts users to verify or edit the information.
5. User verifies or edits the information and selects "Submit."
6. System saves the updated animal information to the database and displays a confirmation message.

=>Alternatives:

If the microchip cannot be scanned or is not detected, the user can manually enter the animal information.

If the animal information already exists in the database, the user can choose to edit or update the information.

=>Exceptions:

If there is a technical issue with the scanning function or the database, the system displays an error message and prompts the user to try again later.

10 Functional Requirements

The Livestock Management System uses Radio Frequency Identification (RFID) technology to give farmers and ranchers an effective and efficient way to manage their cattle. The system's user-friendly interface is made to track and manage livestock's population, health, breeding, and production. The creation of a set of specifications that pinpoint the precise needs and features of the program is important to guarantee the system's success. These specifications must have distinct identities, brief names, explanations, justifications, fit criteria, and acceptance tests. The use cases of the system, which will be used to specify the steps involved in managing the cattle, will be used to derive the functional requirements. To make sure the system satisfies user needs and performs well in a variety of circumstances, non-functional requirements like performance, security, and usability must also be taken into account. The requirements that specify the functions the system must carry out are referred to as functional requirements. Examples of functional specifications for a livestock management system include the following: Using RFID technology, the system must be able to track the whereabouts of specific animals; The system must be able to keep track of and record information about each animal's medical history, including immunizations, ailments, and treatments; Individual animals' breeding histories, including mating dates, pregnant status, and offspring, must be able to be tracked by the system; Based on user-defined criteria, the system must be able to produce reports on animal population, health, and productivity; For data gathering and analysis, the system must be able to interact with already installed barcode scanners and GPS systems.

+F-1 - Animal registration

Description: The system will allow the user to register a new animal, providing information such as the animal's name, breed, age, sex, weight, and picture.

Rationale: Animal registration is a core feature of the system, allowing users to add new animals to the database for tracking and management purposes.

Fit Criterion: The system must allow the user to input all required information and save it to the database. The system must also display the new animal in the animal list view.

Acceptance Tests: AT-F-1.1 - Enter all required information for a new animal and save it to the database; AT-F-1.2 - Verify that the new animal is displayed in the animal list view.

+F-2 - Animal search

Description: The system will allow the user to search for an animal based on its name, breed, age, sex, weight, or any combination of these fields.

Rationale: Animal search is a crucial feature for users to quickly find and access information about specific animals in the system.

Fit Criterion: The system must return search results that match the search criteria entered by the user. The system must also allow the user to refine their search criteria and view additional details about each animal in the search results.

Acceptance Tests: AT-F-2.1 - Search for an animal by its name and verify that the search results contain the expected animal; AT-F-2.2 - Refine a search by adding additional search criteria and verify that the search results are updated accordingly.

+F-3 - Animal health record management

Description: The system will allow the user to view, add, and update health records for each animal, including vaccinations, medications, and medical conditions.

Rationale: Maintaining accurate and up-to-date health records for each animal is critical for ensuring their well-being and managing their care.

Fit Criterion: The system must allow the user to view, add, and update health records for each animal. The system must also provide alerts or notifications for upcoming vaccinations or medications.

Acceptance Tests: AT-F-3.1 - View an animal's health record and verify that it displays all relevant information; AT-F-3.2 - Add a new health record for an animal and verify that it is saved to the database; AT-F-3.3 - Update an existing health record for an animal and verify that the changes are saved to the database.

+F-4 - Animal feeding schedule management

Description: The system will allow the user to create and manage feeding schedules for each animal, specifying the type of food, quantity, and frequency of feedings.

Rationale: Feeding schedules are a crucial aspect of animal care and management, ensuring that each animal receives proper nutrition and care.

Fit Criterion: The system must allow the user to create and manage feeding

schedules for each animal. The system must also provide reminders or alerts for upcoming feedings.

Acceptance Tests: AT-F-4.1 - Create a feeding schedule for an animal and verify that it is saved to the database; AT-F-4.2 - View a feeding schedule for an animal and verify that it displays all relevant information; AT-F-4.3 - Receive a reminder or alert for an upcoming feeding and verify that it displays the correct information.

+F-5: Animal information recording

Description: The system must allow the user to record information about the animal, including species, breed, sex, age, weight, and any relevant medical or behavioral history.

Rationale: To ensure accurate and comprehensive records of each animal are kept.

Fit Criterion: The system successfully records all entered information and allows the user to view and edit the information as needed.

Acceptance Tests:

Enter information for a new animal and verify that all fields are saved correctly.

Edit an existing animal's information and verify that the changes are saved correctly.

+F-6: Animal tracking

Description: The system must track the location of each animal, including where it is housed and any movements between locations.

Rationale: To ensure the safety and proper care of each animal, as well as to enable tracking for research or other purposes.

Fit Criterion: The system accurately records the location of each animal and updates this information in real-time as animals move between locations.

Acceptance Tests:

Move an animal from one location to another and verify that the system updates the animal's location information correctly.

Check the system's location information against the actual location of each animal to verify accuracy.

+F-7: Animal health monitoring

Description: The system must allow the user to record and track the health status of each animal, including any medical treatments or interventions.

Rationale: To ensure the overall health and well-being of each animal, and to provide a history of medical care for research or other purposes.

Fit Criterion: The system successfully records all entered health information and allows the user to view and edit the information as needed.

Acceptance Tests:

Enter health information for a new animal and verify that all fields are saved correctly.

Edit an existing animal's health information and verify that the changes are saved correctly.

11 Data Requirements

Animal ID number

Species of animal

Date and time of tracking

Location data

Health status of animal

Feed and water consumption data

Breeding and reproductive data

Movement and behavior data

12 Performance Requirements

12a Speed and Latency Requirements

The software shall be able to detect and record the location of an animal within 10 seconds of it passing through an RFID reader.

The time between when an animal passes through an RFID reader and when the location data is stored in the database shall not exceed 1 second.

The software shall be able to process at least 100 animal tracking events per second during peak usage.

The time between when an animal tracking event is received by the software and when it is processed and stored in the database shall not exceed 5 seconds.

The software shall be able to generate a report of an animal's location history within 10 seconds of a user's request.

The software shall be able to display real-time location data for up to 50 animals simultaneously without any lag or delay exceeding 1 second.

The system shall be able to read and process RFID tags within 100 milliseconds.

The system shall be able to track the movement of an animal and update its location in the database within 1 second of the RFID tag being read.

The system shall be able to handle a minimum of 1000 RFID tag reads per minute during peak usage periods.

The system shall be able to synchronize data with the cloud server within 5 minutes of new data being captured by the RFID readers.

12b Precision or Accuracy Requirements

ID#1 - Response Time Requirement

Description: The system must respond to user input within 1 second of receiving the input.

Rationale: The system is intended for use in a fast-paced environment where users need to quickly input data and receive a response. Delayed responses could cause frustration and decrease productivity.

Fit Criterion: The system shall respond to 90% of user inputs within 1 second.

Acceptance Tests: Test the system's response time for different user inputs and ensure that 90% of them are responded to within 1 second.

ID#2 - Sensor Polling Requirement

Description: The product will poll the temperature sensor every 5 seconds.

Rationale: The temperature sensor is critical for ensuring the health and safety of the animals. Frequent polling ensures that any changes in temperature are detected quickly and addressed.

Fit Criterion: The product will poll the temperature sensor every 5 seconds.

Acceptance Tests: Test the system's polling frequency and ensure that it is polling the temperature sensor every 5 seconds.

ID#3 - Data Download Requirement

Description: The product will download new animal status parameters within 1 minute of a change.

Rationale: The animal status parameters are critical for ensuring the health and safety of the animals. Frequent updates ensure that any changes in the animals' conditions are detected quickly and addressed.

Fit Criterion: The product will download new animal status parameters within 1 minute of a change.

Acceptance Tests: Test the system's ability to detect changes in animal status parameters and ensure that it is downloading the updated parameters within 1 minute of a change.

12c Capacity Requirements

+ID# - Name: CAP-1 - Storage Capacity

Description: The system will be able to store at least 10,000 records of animal information, including their photos and medical records.

Rationale: The system will be used to manage a large number of animals, and it is important to have the ability to store a significant amount of data to ensure that all relevant information can be stored and accessed easily.

Fit Criterion: The storage capacity of the system will be tested by attempting to store 10,000 records of animal information. If the system is able to store all records without errors or performance issues, it will be considered to have met this requirement.

Acceptance Tests: AT-CAP-1.1 - Attempt to store 10,000 records of animal information and verify that all records are successfully stored without errors.

+ID# - Name: CAP-2 - User Capacity

Description: The system will be able to support a minimum of 50 concurrent users without a significant decrease in performance.

Rationale: The system will be used by multiple users at the same time, and it is important to ensure that the system can handle the expected load without slowing down or crashing.

Fit Criterion: The user capacity of the system will be tested by simulating concurrent usage by 50 users and measuring the system's performance. If the system can handle this load without any significant decrease in performance, it will be considered to have met this requirement.

Acceptance Tests: AT-CAP-2.1 - Simulate concurrent usage by 50 users and measure the system's performance to verify that there is no significant decrease in performance.

+ID# - Name: CAP-3 - Processing Capacity

Description: The system will be able to process at least 100 animal records per minute.

Rationale: The system will be used to manage a large number of animals, and it is important to ensure that it can process records quickly to avoid delays or backlogs.

Fit Criterion: The processing capacity of the system will be tested by attempting to process 100 animal records per minute. If the system can process records at this rate without errors or performance issues, it will be considered to have met this requirement.

Acceptance Tests: AT-CAP-3.1 - Attempt to process 100 animal records per minute and verify that the system can handle this load without errors or performance issues.

13 Dependability Requirements

13a Reliability Requirements

The product will have a mean time between failures (MTBF) of at least 10,000 hours.

The product shall be able to recover from a failure within 30 seconds without any data loss.

The probability of a catastrophic failure that could cause injury or loss of life will be no greater than 1 in 1 million.

The product shall have a backup power source that can keep it operational for at least 24 hours in the event of a power outage.

The product will be able to handle at least 99.99% of requests without any errors or failures.

The product shall be able to detect and report errors or failures within 1 minute of their occurrence.

The product shall have a failover system in place that can take over within 5 minutes in the event of a primary system failure.

The product will have a redundancy level of at least N+1, where N is the number of components required for normal operation.

Conduct a failure and recovery test to ensure the product can recover from a failure within 5 minutes without any loss of data.

Conduct a reliability test to ensure the product has a maximum acceptable failure rate of 1% per year.

—---Follow format—----

+ID# - Error

Description: The product must be reliable and have a low failure rate to minimize disruptions in the business operations.

Rationale: The client has emphasized the importance of reliability for the product to ensure continuous operations and minimize losses due to downtime or data loss.

Fit Criterion: The product shall have a mean time between failures of at least 1000 hours of continuous operation. The product shall be able to recover from a failure within 5 minutes without any loss of data. The product shall have a maximum acceptable failure rate of 1% per year.

Acceptance Tests:

Conduct a stress test to ensure the product can operate continuously for 1000 hours without failure.

Conduct a failure and recovery test to ensure the product can recover from a failure within 5 minutes without any loss of data.

Conduct a reliability test to ensure the product has a maximum acceptable failure rate of 1% per year.

13b Availability Requirements

+ID#1 - Continuous Availability

Description: The RFID animal tracking system shall be available for use 24 hours

a day, 7 days a week, without interruption, except for scheduled maintenance downtime.

Rationale: The system must be continuously available to ensure that animal movements are tracked and recorded accurately without any downtime.

Fit Criterion: The system uptime must be measured over a period of one year, and the availability percentage must be equal to or greater than 99%.

Acceptance Tests: Conduct a test to simulate a failure scenario and measure the time required to restore the system to full functionality. The time taken must not exceed the maximum allowable downtime as defined in the requirement.

+ID#2 - Scheduled Maintenance Downtime

Description: The RFID animal tracking system may be unavailable for use during scheduled maintenance periods.

Rationale: Regular maintenance is necessary to ensure that the system functions optimally and to prevent unexpected downtime.

Fit Criterion: The scheduled maintenance downtime shall be limited to a maximum of 4 hours per month, and the total downtime per year shall not exceed 48 hours.

Acceptance Tests: Conduct a test to verify that the system can be taken offline for maintenance, and can be restored to full functionality within the scheduled maintenance window.

+ID#3 - Partial Functionality

Description: The RFID animal tracking system shall continue to provide at least partial functionality in the event of hardware or software failures.

Rationale: Partial functionality will help ensure that critical animal tracking data can still be captured, even during a system failure.

Fit Criterion: In the event of a failure, the system shall provide at least 50% of its full functionality, and the time required to restore full functionality shall not exceed 24 hours.

Acceptance Tests: Conduct a test to simulate a failure scenario, and verify that the system can continue to capture animal tracking data, even with reduced functionality. The time required to restore full functionality must not exceed the maximum allowable downtime.

The system shall be available for use 24/7, with a maximum downtime of 30 minutes per week for maintenance.

The system shall be available for use during normal business hours (8:00 AM to 5:00 PM), with scheduled downtime of up to 2 hours per week for maintenance.

The system shall be available for use during peak tracking season (May to September), with a minimum uptime of 95% during this period.

The system shall be available for use at all times when animals are being tracked or monitored, with scheduled downtime of up to 4 hours per month for maintenance.

The system shall be available for use during all animal health emergencies, with a maximum downtime of 15 minutes per incident for maintenance or repair.

13c Robustness or Fault-Tolerance Requirements

The product shall continue to track animals and store data locally in case of loss of network connectivity. Once network connectivity is restored, the product shall synchronize the stored data with the central server.

The product shall have redundant power sources and be able to switch seamlessly between them in case of power outage.

The product shall have built-in error detection and correction mechanisms to minimize the impact of hardware or software failures.

The product shall have a disaster recovery plan that outlines procedures for restoring data and functionality in case of a major system failure, such as a natural disaster or cyber attack.

The product shall be designed to handle a high volume of data traffic and be able to scale up or down based on demand without affecting performance or functionality.

The product shall have a user-friendly interface that allows users to easily troubleshoot and resolve common issues, such as lost or damaged RFID tags.

13d Safety-Critical Requirements

The RFID tags used for animal tracking shall weigh no more than 5% of the animal's body weight.

The RFID tags shall be placed no closer than 10 cm to the animal's eyes or other sensitive areas of the body.

The tag reader shall emit an audible and visual alert when a tag is detected within 1 meter of the reader.

The tagging and tracking process shall be performed by trained personnel using humane methods that minimize animal stress and discomfort.

The RFID tags shall be designed such that it cannot be activated accidentally and cause injury to the user.

The tags shall be equipped with an emergency stop button that immediately halts all operation if pressed.

The tags shall be designed to prevent access to live electrical components during operation or maintenance.

14 Maintainability and Supportability Requirements

14a Maintenance Requirements

ID# - Name

Description: Your description here . . .

Rationale: Your rationale here . . .

Fit Criterion: Your fit criteria here . . .

Acceptance Tests: List ID# and/or names here . . .

The software must be able to be upgraded to new versions without losing any data or settings.

Any bug fixes or patches must be provided within 24 hours of the issue being reported.

The software must be compatible with common operating systems and browsers, and any changes to these systems should be accounted for in future releases.

The software should include a system for tracking and managing maintenance requests and tasks.

Any necessary maintenance or updates should be able to be performed remotely, without requiring on-site access to the system.

The software should include clear and comprehensive documentation for both users and developers, including installation instructions, troubleshooting guides, and code documentation.

Regular maintenance and upgrades should be scheduled and communicated in advance to users, with minimal disruption to their use of the system.

The software should be designed with modularity in mind, making it easy to update or replace individual components as necessary.

The development team should provide ongoing support for the software, including responding to user inquiries and providing assistance with troubleshooting and maintenance tasks.

14b Supportability Requirements

Acceptance Tests: List ID# and/or names here . . .
The product shall provide online help documentation accessible from within the application.
The product shall include a user manual in PDF format.
The product shall have a dedicated help desk available during regular business hours.
The product shall include a feature that allows users to submit bug reports directly from the application.
The product shall have an automatic update feature that notifies users of available updates and allows them to easily install them.
The product shall include error logging and reporting capabilities that can be used to diagnose and troubleshoot issues.
The product shall provide training materials and resources to users and administrators.
The product shall have a support team available 24/7 for critical issues or emergencies.

14c Adaptability Requirements

The product must be able to integrate with existing inventory management systems used by the client.

The product must be compatible with RFID readers and tags from multiple vendors.

The product must be able to operate in environments with varying levels of electromagnetic interference.

The product must be able to function in extreme temperatures (-40°C to 70°C).

The product must be able to operate in areas with poor network connectivity.

The product must be able to adapt to changes in the animal tracking regulations

of different countries.

The product must be scalable to accommodate increasing numbers of animals being tracked.

The product must be able to handle different types of animal data, such as DNA samples or behavioral observations.

14d Scalability or Extensibility Requirements

The system must be able to handle at least 10,000 animal tracking records per day. This number is expected to grow by 50% every year for the next five years.

The system must be designed to accommodate additional RFID readers as the number of animals being tracked increases.

The software must be scalable to support multiple farms and ranches, with the ability to easily add new ones as they are acquired.

The system must be able to handle at least 1,000 simultaneous users accessing the database. This number is expected to grow by 25% every year for the next three years.

The software architecture must be modular and flexible to allow for easy integration with new technologies, such as new types of sensors or tracking devices.

14e Longevity Requirements

The product shall remain functional and supported for a period of at least 10 years from the date of release.

The product must be compatible with all future versions of the operating system for at least 3 years from the date of release.

The product must be able to accommodate future upgrades and enhancements for a minimum of 5 years from the date of release.

The product shall have a minimum lifespan of 7 years with no major upgrades or maintenance required during that time.

The product must have a minimum warranty period of 2 years from the date of purchase.

15 Security Requirements

15a Access Requirements

Only authorized personnel, such as veterinarians or animal handlers, can access specific animal tracking data.

Access to sensitive information, such as medical records or breeding information, is limited to specific user roles or individuals with appropriate clearance.

Access to the software's administrative functions, such as adding or removing users, is restricted to designated administrators.

The system must have mechanisms to detect and prevent unauthorized access attempts, such as password policies or two-factor authentication.

List of user roles and associated access permissions.

Description of the authentication and authorization mechanisms to be used in the system.

15b Integrity Requirements

The software shall ensure that all data collected and stored is accurate and free from errors.

The software shall provide mechanisms to detect and prevent unauthorized access to data or system functions.

The software shall provide backup and recovery procedures to prevent data loss in the event of system failure or corruption.

The software shall ensure that all data is securely stored and transmitted to prevent theft or loss.

The software shall provide audit trails and logs to track changes to data or system functions and detect any unauthorized modifications.

The product shall ensure that all data entered into the system is valid and accurate, and shall prevent incorrect or invalid data from being introduced.

The product shall have measures in place to protect against intentional abuse or misuse by authorized users, such as access control and authentication mechanisms.

The product shall have backup and recovery procedures in place to ensure the integrity of data in the event of system failures or other disruptions.

The product shall have a mechanism for detecting and reporting any unauthorized modifications or tampering with the data or the system.

The product shall be designed to minimize the risk of data corruption or loss due to software errors or hardware failures.

15c Privacy Requirements

The product shall ensure the confidentiality of sensitive animal health information, including medical records and treatment history, in compliance with relevant privacy laws and regulations.

The product shall collect and store only necessary information, and obtain consent from animal owners before collecting and using their personal information.

The product shall provide animal owners with access to their own data, and allow them to request corrections or deletions of their personal information.

The product shall implement appropriate security measures, such as encryption and access controls, to protect sensitive data from unauthorized access or disclosure.

The product shall inform animal owners of any data breaches or unauthorized disclosures of their personal information, in accordance with applicable laws and regulations.

The product shall comply with all applicable privacy laws and regulations, including GDPR, CCPA, and HIPAA.

The product shall maintain a record of all personal information collected, used, and disclosed, and provide individuals with access to this record upon request.

The product shall only collect and use personal information for the purpose it was obtained, and not disclose it to third parties without the individual's consent.

The product shall allow individuals to access and correct their personal information stored in the system.

The product shall maintain the confidentiality and security of personal information stored in the system, using appropriate encryption and access controls.

15d Audit Requirements

The product shall retain a log of all RFID tag reads, including the time, date, and location of each read event, to enable auditing of animal movement.

The product shall provide an audit trail of all changes to animal records, including the date, time, and user who made the changes, to enable tracking of changes and identification of potential errors or fraudulent activity.

The product shall retain a record of all access attempts to the system, including unsuccessful attempts, and provide a log of successful logins, to enable auditing of user activity and to identify potential security breaches.

The product shall provide the ability to generate reports on all audit data, including animal movement, record changes, and user activity, to enable easy review and analysis by auditors and regulatory bodies.

The product shall comply with all relevant audit regulations and standards, such as the Sarbanes-Oxley Act or HIPAA, to ensure that the system meets legal requirements for data retention and auditability.

The product shall encrypt and securely store the audit trail data to prevent unauthorized access or modification.

The system shall maintain a log of all administrative actions, such as user account creation and modification, to ensure accountability and traceability.

15e Immunity Requirements

The product shall be updated regularly to ensure that the latest security patches and antivirus software are installed.

The product shall provide real-time monitoring of system activity to detect any unauthorized attempts to access or modify data.

The product shall scan all incoming data for viruses and other malicious software and quarantine any infected files.

The product shall be updated regularly to ensure that its virus definitions are up-to-date.

The product shall not allow unauthorized software to be installed or executed on the system.

The product shall provide a secure login system that prevents unauthorized access to the software and data.

The product shall encrypt sensitive data to protect it from interception or theft.

The product shall have a backup and recovery system in place to prevent data loss due to malicious attacks or system failures.

16 Usability and Humanity Requirements

16a Ease of Use Requirements

The software shall be intuitive and easy to use for veterinary staff with minimal training.

The software shall be designed with a clear and concise user interface.

The software shall provide clear feedback to the user, indicating the success or failure of each data input.

The software shall minimize the risk of data entry errors.

The software shall have the ability to generate reports and visualizations of the data that are easy to interpret and understand.

The software shall be easy for farmers with no technical background to use.

The software shall be intuitive and require minimal training.

The software shall have a clear and simple interface that enables users to quickly access and interpret the data.

The software shall provide clear and concise instructions for use.

16b Personalization and Internationalization Requirements

The software shall support multiple languages, including English, Spanish, French, and German. Users shall be able to change their language preference at any time, and the change shall take effect immediately without requiring a software restart.

The software shall allow users to select their preferred language upon

installation.It will be tested with users from at least five different countries to ensure that it functions correctly with various language and currency settings.

The software shall support different currency symbols and decimal conventions based on the user's location.

The software shall allow users to customize the display of data based on their personal preferences, such as font size and color scheme.

The software shall allow users to set up and save customized reports based on their specific needs.

The software shall allow the user to select their preferred date and time format, such as 12-hour vs 24-hour time, or different date formatting conventions.

The software shall support different units of measurement, such as metric vs imperial units.

The software shall allow the user to customize the appearance and layout of the user interface, including the ability to change color schemes or font sizes.

The software shall be compatible with different operating systems and platforms commonly used in different countries, such as Windows, MacOS, or Linux.

The software shall support different character sets and encoding schemes to properly display text in different languages.

The software shall provide appropriate localization and translation of all user-facing text, including error messages, tooltips, and help documentation.

16c Learning Requirements

A new user shall be able to use the basic features of the software within 30 minutes of training.

The software shall have a user-friendly interface and provide tooltips for all functions.

The software shall provide a step-by-step tutorial for first-time users.

The user manual shall be provided in multiple languages to cater to users with different language preferences.

The software shall have a help center with searchable FAQs and video tutorials.

The software shall provide real-time feedback and error messages to guide the

user in correcting mistakes.

The software shall allow users to customize their dashboard for easy access to frequently used functions.

The software shall provide a comprehensive training program for advanced users who require in-depth knowledge of the software.

The product shall be easy for a veterinarian with basic computer skills to learn how to use.

A ranch hand with no previous experience using animal tracking software shall be able to use the product effectively within 2 hours of training.

The product shall include interactive tutorials and tooltips to help users learn how to use advanced features.

Users shall be able to access a comprehensive user manual and online support resources to aid in their learning of the product.

A researcher with no previous experience using RFID technology shall be able to learn how to use the product for their research project within 1 week of training.

16d Understandability and Politeness Requirements

The product shall use terminology and concepts that are familiar to farmers and ranchers, such as breed, gender, age, and weight.

The product shall provide clear and concise instructions for performing common tasks, such as adding new animals, updating information, and generating reports.

The product shall provide helpful error messages that explain the problem and suggest possible solutions.

The product shall avoid using technical jargon or acronyms that are not commonly known in the agriculture industry.

The product shall provide contextual help that explains the purpose and functionality of each feature in a way that is easy to understand.

The software shall use commonly used and recognized symbols and icons for functions such as "add animal," "delete animal," and "search for animal."

The software shall use terminology familiar to the animal tracking industry, such as "tag ID" and "reader location."

The software shall provide clear and concise error messages that are easily understandable to the user, such as "Tag not detected" or "Invalid reader

location."

The software shall avoid using technical jargon or acronyms that are not widely understood by the intended audience.

The software shall provide contextual help and explanations for any unfamiliar terms or concepts.

16e Accessibility Requirements

The product shall be usable by individuals with motor disabilities who may require alternative input devices, such as voice recognition or alternative keyboard configurations.

The product shall provide audio descriptions or alternative text for visual content to support users with visual impairments.

The product shall be usable with assistive technology such as screen readers, magnifiers, or switch devices.

The product shall have adjustable font sizes and color contrasts to support users with visual impairments.

The product shall provide closed captions or transcripts for audio content to support users with hearing impairments.

The product shall be designed with clear and consistent navigation to support users with cognitive impairments or learning disabilities.

The product shall avoid using flashing or rapidly changing content to support users with photosensitive epilepsy.

16f User Documentation Requirements

The product shall provide a user manual that explains how to operate the software and how to interpret the data output. The manual shall be available in digital format as well as printed form. The manual shall be written in plain language and shall include screenshots and diagrams to aid in understanding. The manual shall be updated whenever there are significant changes to the software or its features. In addition, the product shall provide a technical specification document that details the hardware and software requirements for using the product, and a service manual that outlines procedures for maintenance and repair of the system.

All documentation shall mostly be available in English and Spanish.

16g Training Requirements

Users must complete a 2-hour training session before being allowed to use the software.

A training manual will be provided to all users, and a training video will be available on the company's website.

A training program will be developed for new users, and refresher training will be provided annually for existing users.

The software must be intuitive and easy to use, requiring minimal training for users.

Training must cover basic use of the software as well as troubleshooting and problem-solving techniques.

Low end user without any prior knowledge of RFID will understand within 1 week of training

17 Look and Feel Requirements

17a Appearance Requirements

The user interface shall have a clean and modern design.

The product shall use animal-related icons and imagery.

The product shall follow the branding guidelines of the animal tracking industry.

The font size and color scheme shall be consistent throughout the application.

The product shall use colors that are easily distinguishable by colorblind users.

The product shall have a color scheme that is easily distinguishable from other equipment used in the same environment.

The product shall use fonts that are easy to read for users with low vision.

The product shall have a modern and professional design that appeals to veterinary professionals.

The product shall prominently display the logo of the manufacturer on the main screen.

The product shall have a consistent visual style throughout all screens and menus.

The product shall use a font size of at least 14 points to ensure legibility on smaller screens.

The product shall use intuitive icons and symbols to represent different functions and features.

The product shall have a clean and uncluttered design that makes it easy to navigate and use.

The product shall use a color scheme that is calming and non-threatening to animals during use.

The product shall have a design that is durable and resistant to damage from regular use in outdoor and farm environments.

17b Style Requirements

The product shall have a friendly and approachable style to appeal to a younger audience.

The product shall have a modern and sleek design to appeal to tech-savvy users.

The product shall have a playful and colorful style to appeal to user.

The product shall have a minimalist and elegant design to appeal to a sophisticated audience.

The product shall have a rugged and durable style to appeal to outdoor enthusiasts.

The product packaging shall have a professional and sophisticated design to reflect the quality of the product.

The product shall be designed with a warm and inviting style.

18 Operational and Environmental Requirements

18a Expected Physical Environment

The product can operate well in a temperature range of -20°C to 50°C.

The product shall be usable with one hand while the user is walking or standing on a moving vehicle.

The product shall be water-resistant and withstand exposure to rain and humidity.

The product shall not emit harmful radiation or interfere with other electronic equipment in the environment.

The product shall be able to operate in areas with poor or no network coverage.

The product shall be able to withstand shocks and vibrations during transportation and handling.

The product shall be able to operate in high-altitude environments.

The product shall be designed to prevent damage from dust and debris.

The product shall be able to operate in areas with low or high levels of electromagnetic interference.

The product shall be able to operate in areas with extreme weather conditions such as snow, wind, and sandstorms.

18b Requirements for Interfacing with Adjacent Systems

The product shall be able to export data to a specific format required by a third-party partner application.

The software must be able to import data from a specific brand of RFID reader.

Our system must be able to integrate with the customer's existing inventory management software.

The product shall be able to interface with the database used by the customer's accounting system.

The software must be able to send alerts and notifications to a mobile application used by field personnel.

The product shall be able to interface with the customer's existing security system for access control.

Our system must be able to integrate or communicate with the customer's existing cloud storage solution. The data exchange must happen in real-time with minimal latency to avoid any delay in the tracking data.

The software must be able to connect to the animal tracking devices via wifi or Bluetooth.

18c Productization Requirements

The product shall be able to be installed and compatible on both Windows and Mac operating systems.

The product shall be packaged with a user manual and installation guide.

The product shall be licensed on a per-user basis, with a maximum of 10 users per license.

The product shall include automatic software updates to ensure compatibility with new RFID readers and technologies.

The product shall be shipped in a sturdy, waterproof container to protect it from damage during transportation.

18d Release Requirements

The product shall have a major release every 2 years and minor releases every 6 months.

All releases shall be accompanied by release notes detailing new features, bug fixes, and any known issues.

The product shall have a beta testing period of 2 weeks before any major release.

Each release shall be thoroughly tested on at least 3 different operating systems.

The product shall have a rollback plan in place for any release that causes major issues for end users.

All releases shall be digitally signed to ensure authenticity and prevent tampering.

The product shall have a release schedule that aligns with industry events and conferences.

Each release shall have a clear upgrade path and instructions for users.

19 Cultural and Political Requirements

19a Cultural Requirements

The product shall not be offensive to any animal welfare groups or organizations.

The product shall be able to handle and display animal identification numbers according to the regulations of the country/region where it will be used.

The product shall include language support for all languages commonly spoken in regions where animal tracking is required.

The product shall comply with ethical guidelines and standards for the use of animals in research and agriculture.

The product shall be designed with consideration for the cultural sensitivities of Indigenous communities that may use the software for tracking traditional hunting practices.

19b Political Requirements

The product shall comply with all applicable laws and regulations related to animal tracking and data privacy.

The product shall include a feature that allows for easy data export in the event of a government audit or investigation.

The product shall not include any functionality that could be used for illegal or unethical purposes.

The product shall be designed in a way that supports the political agenda of the client company or third-party stakeholder.

The product shall meet the requirements of any government contracts or grants that fund its development.

The product shall not infringe on any patents or intellectual property rights held by the client company or third-party stakeholder.

The product shall meet the specific security requirements of the client company or third-party stakeholder, such as encryption protocols or access controls.

The product shall be designed in a way that aligns with the political views or values of the client company or third-party stakeholder.

The product shall be tested and validated according to a specific set of criteria established by the client company or third-party stakeholder.

The product shall comply with any ethical standards or codes of conduct established by the client company or third-party stakeholder.

20 Legal Requirements

20a Compliance Requirements

The system will comply with all applicable regulations and guidelines set forth by the United States Department of Agriculture (USDA) for animal identification and traceability.

The system shall be designed to comply with the European Union's regulations on animal identification and traceability, including Council Regulation (EC) No 21/2004.

The system shall comply with all relevant environmental regulations and guidelines, including those related to disposal of electronic waste.

The system shall be designed to comply with the Health Insurance Portability and Accountability Act (HIPAA) regulations related to the privacy and security of personal health information.

The system shall comply with the General Data Protection Regulation (GDPR) when processing personal data of individuals located in the European Union.

The system shall comply with all relevant international trade regulations, including those related to the import and export of goods and technology.

The system shall comply with all relevant safety regulations, including those related to electromagnetic interference (EMI), electrical safety, and product labeling.

The software shall be compliant with the FDA regulations regarding the use of RFID technology in food production and distribution.

The system shall meet the requirements for radio frequency emissions set by the Federal Communications Commission (FCC) and other relevant authorities.

The software shall be compliant with industry standards such as ISO 11784 and ISO 11785 for animal identification and tracking.

The system shall comply with all applicable laws and regulations related to animal welfare and tracking, including but not limited to the Animal Welfare Act

and the Animal Disease Traceability program.

20b Standards Requirements

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The product shall comply with ISO 11784 and 11785 standards for animal identification.

The product will comply with the EPCglobal Class 1 Gen 2 standard for RFID tag communication.

The product will comply with the Electronic Animal Identification Standard of the National Institute of Standards and Technology (NIST).

The product will be developed according to the Agile software development methodology as per company standards.

The product will adhere to the IEEE 802.11 standard for wireless communication protocols used in RFID readers.

21 Requirements Acceptance Tests

21a Requirements – Test Correspondence Summary

	A	B	C	D	E	F	G	H	I	J	K	L
1		Requirements										
2	Test	Req 1	Req 2	Req 3	Req 4	Req 5	Req 6	Req 7	Req 8	Req 9	Req 10	Req 11
3	Test 1	X										
4	Test 2	X										
5	Test 3	X										
6	Test 4		X									
7	Test 5		X									
8	Test 6		X									
9	Test 7		X									
10	Test 8		X									
11	Test 9		X									
12	Test 10		X									
13	Test 11			X								
14	Test 12			X								
15	Test 13			X								
16	Test 14			X								
17	Test 15			X								
18	Test 16			X								
19	Test 17				X							
20	Test 18				X							
21	Test 19				X							
22	Test 20				X							
23	Test 21				X							
24	Test 22				X							
25	Test 23				X							
26	Test 24				X							
27	Test 25				X							
28	Test 26				X							
29	Test 27					X						
30	Test 28					X						
31	Test 29					X						
32	Test 30					X						
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42	Test 40							X				
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45	Test 43								X			
46	Test 44								X			
47	Test 45									X		
48	Test 46									X		
49	Test 47										X	
50	Test 48										X	
51	Test 49											X
52	Test 50											X
53	Test 51											X
54	Test 52											X
55	Test 53											X

21b Acceptance Test Descriptions

Acceptance tests:

1) Data Requirements:

Test 1: The software can store animal data in a secure and centralized database.

Test 2:The software can ensure data accuracy and completeness through data validation and error checking.

Test 3:The software will provide data backup and recovery mechanisms to prevent data loss.

2) Performance Requirements

2a. Speed and Latency Requirements:

Test 4:The product can respond to tag readings within 100ms for 95% of reads.

Test 5:The product can read a minimum of 100 tags per minute with no errors.

Test 6:The product can transmit tag data to the database within 2 seconds of reading.

2b. Precision or Accuracy Requirements:

Test 7:The product can identify and track the correct animal tag with at least 99% accuracy.

Test 8:The product can record the animal's location within a margin of error of +/- 1 meter.

2c. Capacity Requirements:

Test 9:The product can support a minimum of 1000 unique animal tags in the system at one time.

Test 10:The product can store tag data for a minimum of 1 year without data loss.

3) Dependability Requirements

3a. Reliability Requirements:

Test 11:The product can operate continuously for 30 days without failure or errors.

Test 12:The product can recover from a system crash within 5 minutes with no data loss.

3b. Availability Requirements:

Test 13:The product will be available for use 99% of the time during regular operating hours.

Test 14:The product can send an alert to the system administrator within 5 minutes of any downtime.

3c: Robustness or Fault-Tolerance Requirements:

Test 15:The product will continue to operate even if one reader fails or loses power.

Test 16:The product can be able to recover data from a failed reader once it is restored.

4) Maintainability and Supportability Requirements

4a. Maintenance Requirements:

Test 17:The software shall be easy to maintain and update.

Test 18:The software can provide automated software updates to ensure security and stability.

4b. Supportability Requirements:

Test 19:The software can provide user documentation and support materials.

Test 20:The software can provide a user support hotline for technical assistance.

4c. Adaptability Requirements:

Test 21:The software can be adaptable to new RFID hardware and technology advancements.

Test 22:The software support integration with other animal tracking systems.

4d. Scalability or Extensibility Requirements:

Test 23:The software will be able to accommodate additional animal populations and tracking data.

Test 24:The software can be able to integrate with third-party applications and systems.

4e. Longevity Requirements:

Test 25:The software can have a minimum lifespan of 5 years.

Test 26:The software can provide upgrade paths to new software versions or technology advancements.

5) Security Requirements

5a: Access Requirements:

Test 27:The product will require a secure login to access the system.

Test 28:The product can restrict access to sensitive data based on user roles and permissions.

5b: Integrity Requirements:

Test 29:The product can encrypt all data transmitted between the reader and the database.

Test 30:The product can detect and prevent any attempts to tamper with tag data in the system.

5c. Privacy Requirements:

Test 31:The product can store sensitive data (such as animal health, or user authentication)

6) Usability and Humanity Requirements

6a. Ease of Use Requirements:

Test 32:Users can be able to navigate the software and complete common tasks without requiring more than 3 clicks.

6b. Personalization and Internationalization Requirements:

Test 33:The software will provide the ability to switch between different languages and regional settings, such as time zone and date format.

6c. Learning Requirements:

Test 34:The software include a tutorial or onboarding process for new users to learn how to use the software.

6d. Understandability and Politeness Requirements:

Test 35:Error messages can be written in clear and understandable language, avoiding technical jargon and being polite in tone.

6e. Accessibility Requirements:

Test 36:The software can be designed to be accessible to users with disabilities, such as providing keyboard shortcuts and alternative text for images.

6f. User Documentation Requirements:

Test 37:The software will include a user manual or online help system to assist users in learning how to use the software.

6g. Training Requirements:

Test 38:The software can be designed to be easy to train new users on, with training materials provided if necessary.

7)Look and Feel Requirements

7a. Appearance Requirements:

Test 39:The software can have a modern and professional appearance, with a clean and uncluttered interface.

7b. Style Requirements:

Test 40:The software follow the company's brand guidelines for color scheme and typography.

8) Operational and Environmental Requirements

8a. Expected Physical Environment:

Test 41:The software can operate in a range of environmental conditions, such as varying temperatures and humidity levels.

8b. Requirements for Interfacing with Adjacent Systems:

Test 42:The software can be able to interface with the RFID hardware used for animal tracking, as well as any other systems used in conjunction with the software.

8c. Productization Requirements:

Test 43:The software can be packaged and distributed in a way that is easy for customers to install and use.

8d. Release Requirements:

Test 44:The software will follow a regular release schedule, with new features and bug fixes released on a quarterly basis.

9) Cultural and Political Requirements

9a. Cultural Requirements:

Test 45:The software can be designed to be culturally sensitive, avoiding any content or imagery that could be considered offensive or inappropriate in any particular culture or region.

9b. Political Requirements:

Test 46 :The software will not violate any laws or regulations in any countries where it is used, including laws related to data privacy and protection.

10) Legal Requirements

10a. Compliance Requirements:

Test 47:The software can comply with all relevant laws and regulations, including GDPR and HIPAA.

10b. Standards Requirements:

Test 48:The software can meet industry standards for RFID technology and animal tracking, such as ISO 11784 and ISO 11785.

11) Functional Requirements:

Test 49:The software will allow users to add, edit, and delete animal data through a user-friendly interface.

Test 50:The software will provide a search function to locate animals based on various criteria.

Test 51:The software can generate reports on animal movement and behavior patterns.

Test 52:The software can integrate with existing RFID hardware to collect and store animal

tracking data.

Test 53:The software can generate unique RFID tags for each animal that is added to the system.

III Design

22 Design Goals

The Livestock Management System's design objectives include producing a user-friendly interface that is simple to use and enables users to easily get the data they require. The system must deliver up-to-the-minute data on cattle health, reproduction, population, and output with exceptional reliability and accuracy. It should be planned to reduce mistakes and get rid of inconsistent data. The system ought to be scalable, enabling simple growth and expansion as the demands of the user change. In order to suit the individual requirements of many users, it should also be simple to customize, including the capability to add or remove features as necessary. The system should also be very secure, guaranteeing user privacy and confidentiality and preventing unauthorized access to important data.

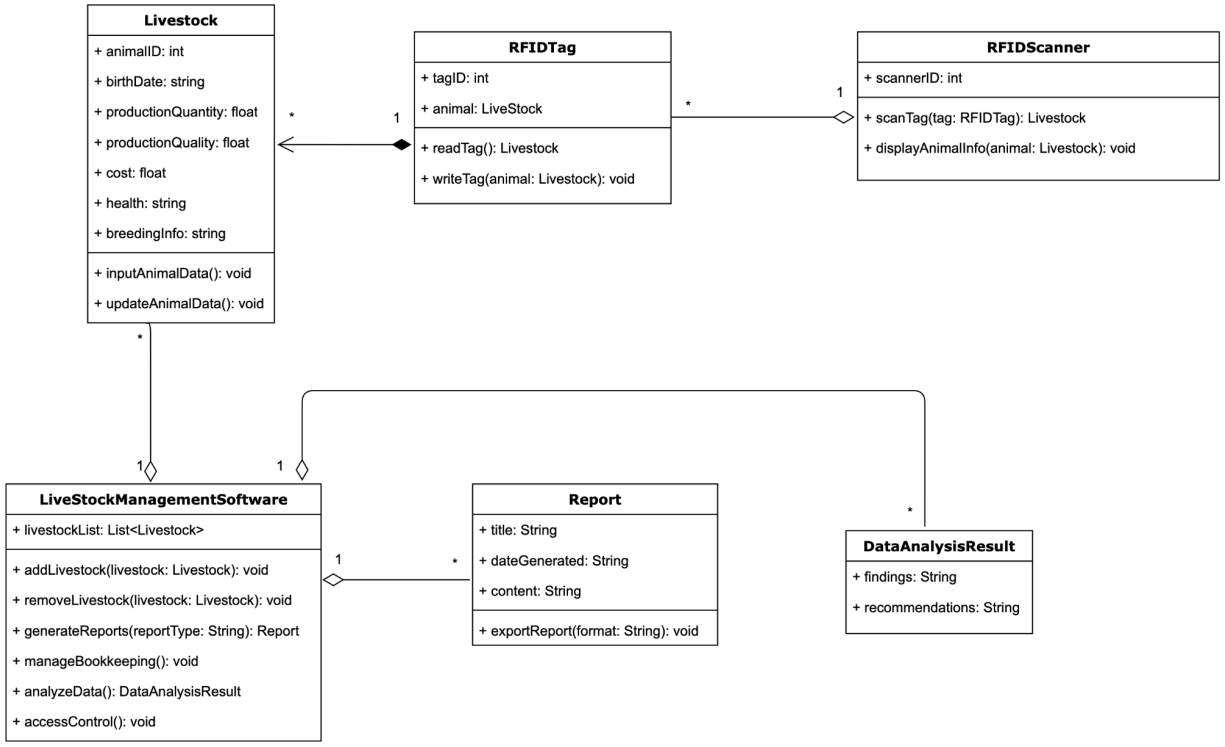
With an emphasis on usability, efficiency, and simplicity, the system should be created with the end-user in mind. Ultimately, the system must be economical, needing little upkeep and care while offering the user the greatest possible benefit. These design objectives will be met by utilizing cutting-edge hardware and software engineering, rigorous testing, and quality assurance procedures, as well as modern software development techniques and technologies.

23 Current System Design

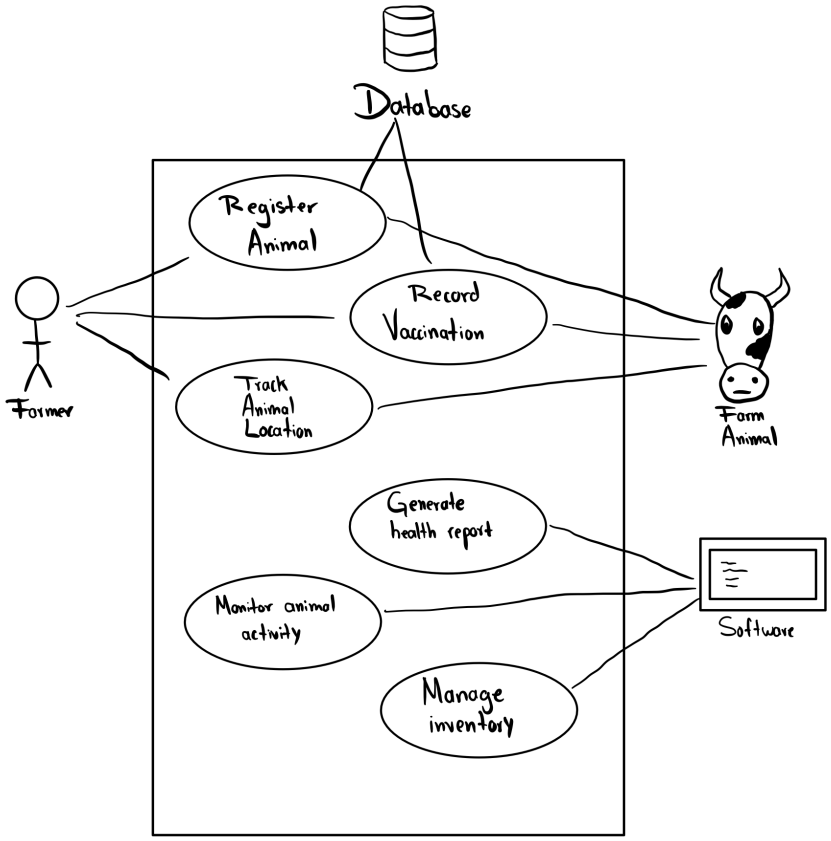
The Livestock Management System, a new system on the market, distinguishes itself from its rivals by providing a thorough and user-friendly interface to manage and track the health, breeding, population, and productivity of livestock. The Livestock Management System uses Radio Frequency Identification (RFID) technology to automate the procedure and remove errors brought on by human participation, in contrast to conventional livestock management systems that rely on manual data entry and record-keeping. The system's interoperability with other devices, such as barcode scanners and GPS systems, improves its effectiveness and gives farmers and ranchers a comprehensive solution for effectively managing their animals. The Livestock Management System is also made to be easily adaptable and scalable to fit the unique requirements of each farm or ranch. Thus, the Livestock Management System is an innovative and game-changing approach to livestock management because of its distinct characteristics and advantages, which have no direct counterparts in the market.

24 Proposed System Design

24a Initial System Analysis and Class Identification



24b Dynamic Modelling of Use-Cases



24c Proposed System Architecture

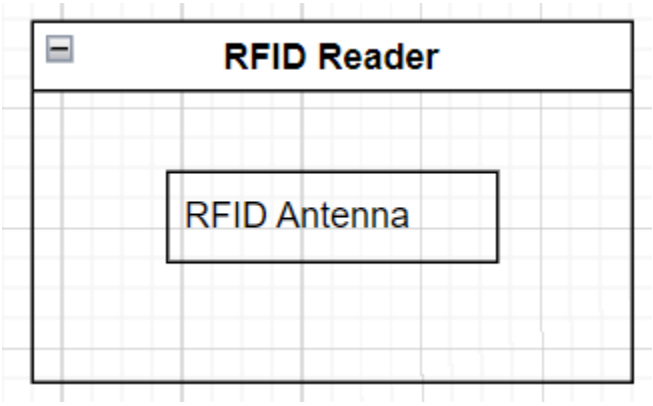
The Client-Server architecture is the best software architecture to use for this project based on the needs and objectives of the Livestock Management System. In this design, a client handles user input and interaction, while a server handles requests and gives the client access to data. The Livestock Management System is an example of an application that benefits from the client-server architecture since it often exchanges data between several clients and the server.

More flexibility and scalability are made possible by the network connection used in this design between the client and server. A robust, centralized system that can manage massive volumes of data and simultaneous requests from numerous clients can host the server. Additionally, because the server may be set up with rigorous access controls and security measures, this architecture offers secure and regulated access to the data.

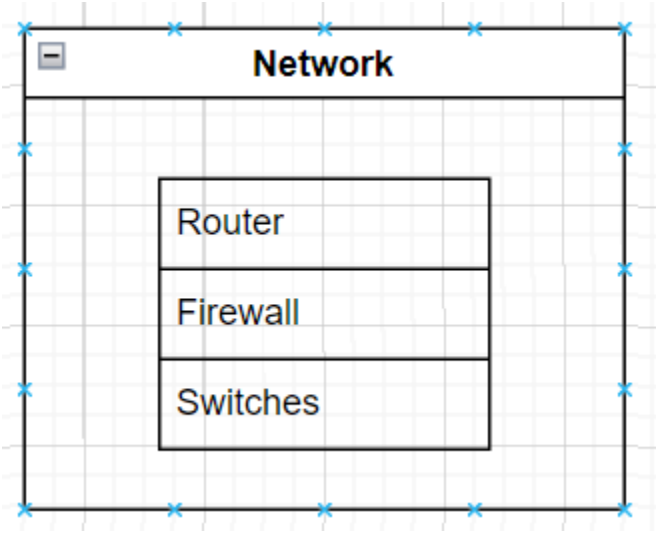
The client-server architecture's capacity to maintain data consistency across numerous clients is another advantage. This is significant for the Livestock Management System because efficient livestock management depends on accurate and current information. The system can guarantee that all users have access to the same information by centralizing data on the server and granting controlled access to clients.

24d Initial Subsystem Decomposition

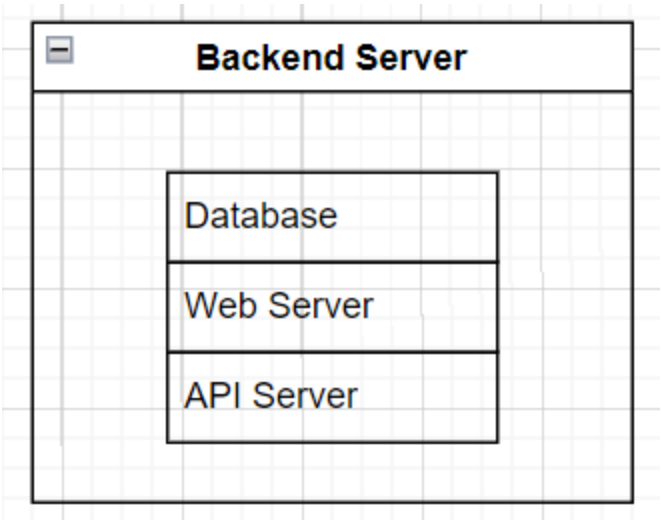
RFID Reader: This component is responsible for reading the RFID tags on the animals and transmitting that data to the backend server.



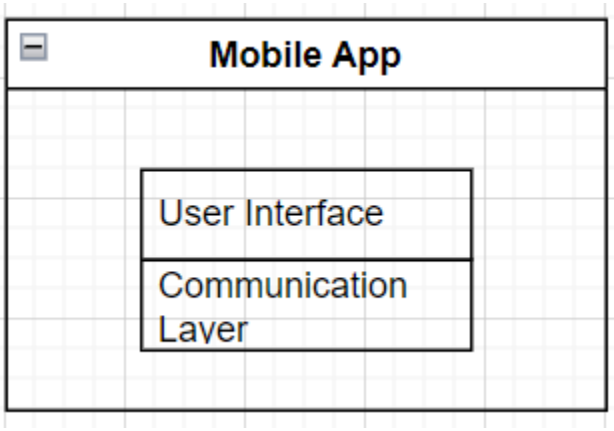
Network: This component enables communication between the RFID reader, mobile app, and backend server.



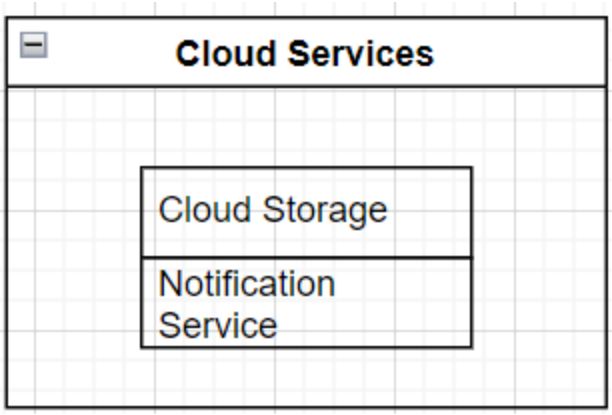
Backend Server: This component processes and stores the data collected by the RFID reader, and provides a central point of access for the mobile app and any other authorized systems to access and manipulate the data.



Mobile App: This component provides a user interface for animal tracking data, allowing users to view and interact with the data collected by the RFID reader and backend server.

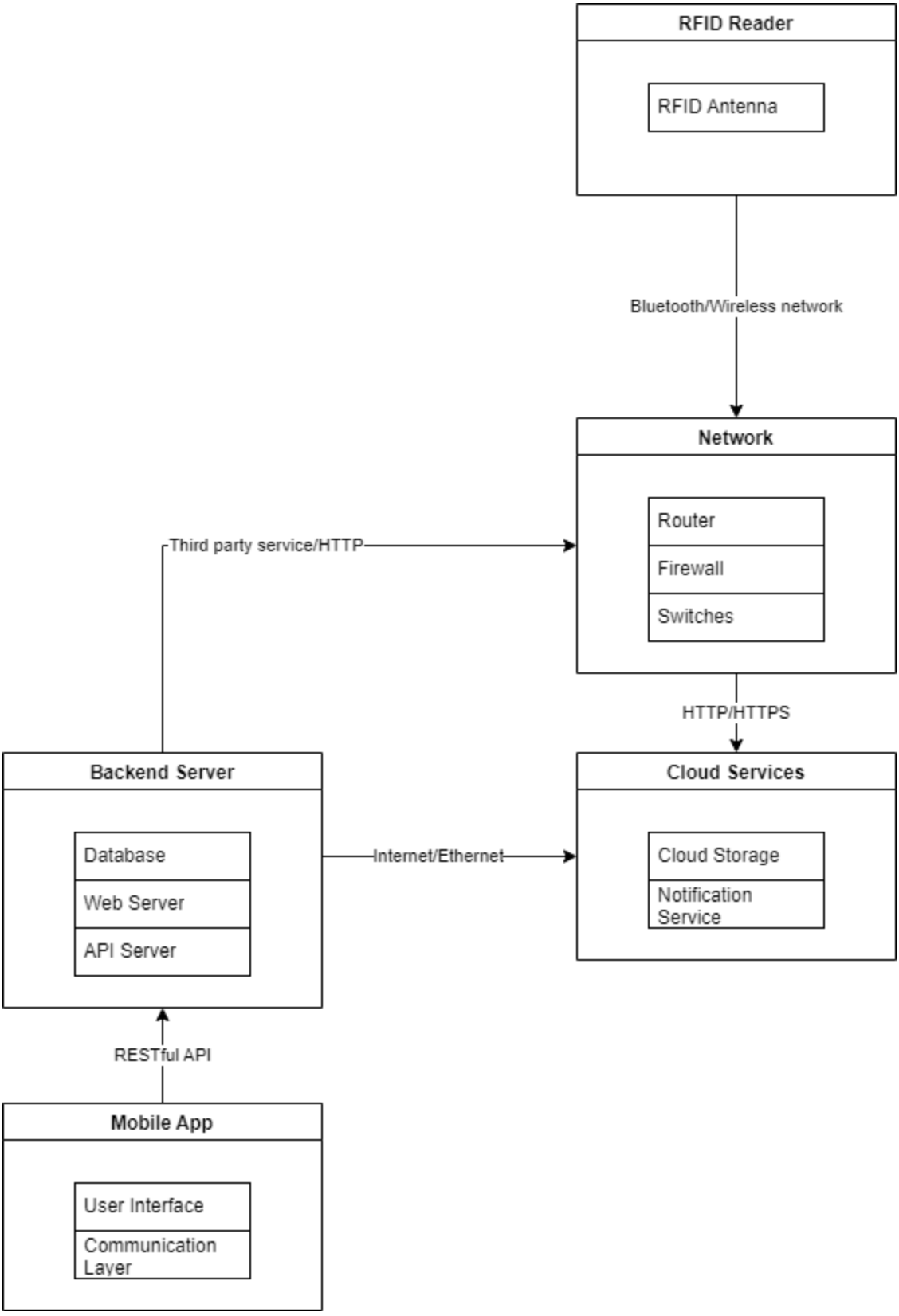


Cloud Services: This component provides the necessary infrastructure and resources to support the backend server, such as data storage, computing resources, and security.



25 Additional Design Considerations

25a Hardware / Software Mapping


RFID Reader
RFID Antenna
Bluetooth/Wireless network
Network
Router
Firewall
Switches
Third party service/HTTP
HTTP/HTTPS
Backend Server
Database
Web Server
API Server
Internet/Ethernet
Cloud Services
Cloud Storage
Notification Service
RESTful API
Mobile App
User Interface
Communication Layer

25b Persistent Data Management

The Livestock Management System's design must include persistent data management. Data including individual animal and herd productivity records, breeding details, and animal health records must be stored and managed by the system. A trustworthy and strong database management system is needed to do this. Large data volumes, quick storage and retrieval, as well as data integrity and security, are all requirements for the database management system.

The system must include backup and recovery techniques in order to guarantee that the data is accessible even in the case of system failure or crashes. Data should be automatically backed up by the system on a regular basis and kept in a secure location. The system should be able to restore data from the most recent backup in the case of a system failure or crash.

The security and confidentiality of the data must also be guaranteed by the data management system. To ensure that only those with the proper authority can access the data, the system must include authentication and authorisation processes. The system must also be built to guard against data loss brought on by malicious attacks or illegal access.

25c Access Control and Security

For the Livestock Management System, there are various security and access control issues. The safety of private and delicate information, such as financial information and records of animal breeding and health, is one of the main issues. The disclosure, modification, or access of this information must be prohibited by law. Strong authentication methods like multi-factor authentication and password policies should be used to govern access to the system, and access should be limited based on user roles and privileges. To further protect data while it is in transit and at rest, data encryption should be used.

The security of the RFID technology used to track and control animals is another issue. Illegal use of the RFID technology could lead to inaccurate readings, incorrect animal identification, or even theft. To avoid unauthorized usage, access to RFID readers and other equipment should be controlled and monitored. The Livestock Management System ought to provide tools for monitoring and reporting any unexpected or dubious RFID-related activities.

25d Global Software Control

Version control and change management may be major issues for the livestock management system's global software control. It's crucial to have a strong version control system in place as the system develops and new features are added so that changes can be tracked and readily undone if necessary. Also, a change management procedure needs to be designed to guarantee that modifications are thoroughly

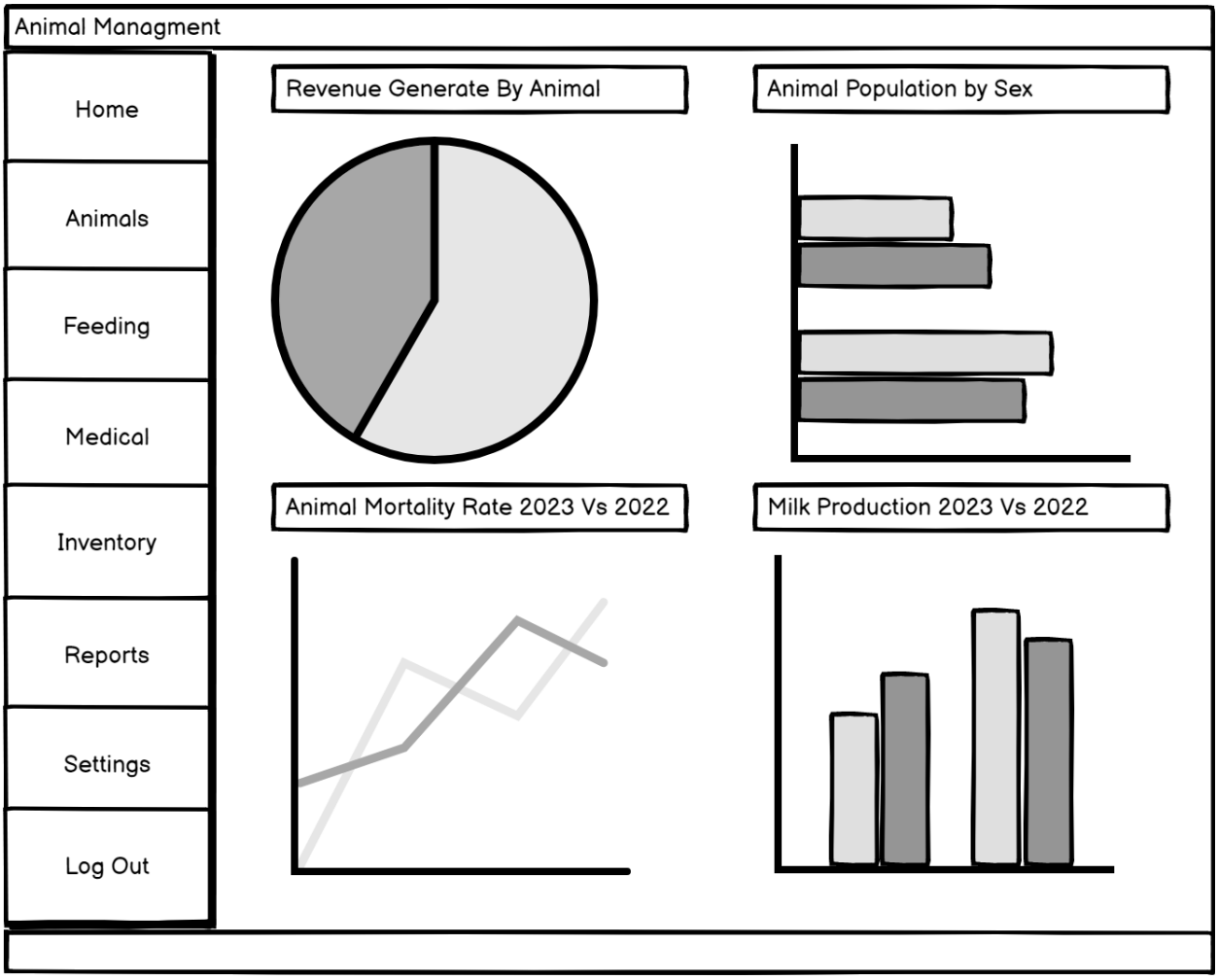
examined and approved before being implemented on the live system. User acceptance testing, automated testing, and code reviews could all fall under this category. The requirement to have disaster recovery plans in place and system backups in order to guard against data loss or system failures is another control concern.

25e Boundary Conditions

A system's behavior at the boundaries of its operation is influenced by boundary conditions, which are restrictions or limitations. Some boundary conditions to take into account in the context of the Livestock Management System are as follows:

- Environment: The system must be able to function in a range of environmental circumstances, such as extremely high or low temperatures, high or low humidity, and dust.
- Physical restrictions: The system must be able to function within the restrictions of the farm or ranch housing the livestock. This includes places with a meager supply of power or weak network access.
- User boundaries: From experienced ranchers to inexperienced farmers, the system must be made to accommodate users with various levels of technical expertise.
- Data limits: The system needs to be able to manage a range of data kinds, such as sensor data, environmental data, and animal data. Additionally, it must be able to manage data from many sensors, including RFID readers, GPS trackers, and others.
- Limitations on time: The system must be able to manage historical data for analysis and reporting purposes as well as real-time or almost real-time data handling.

25f User Interface

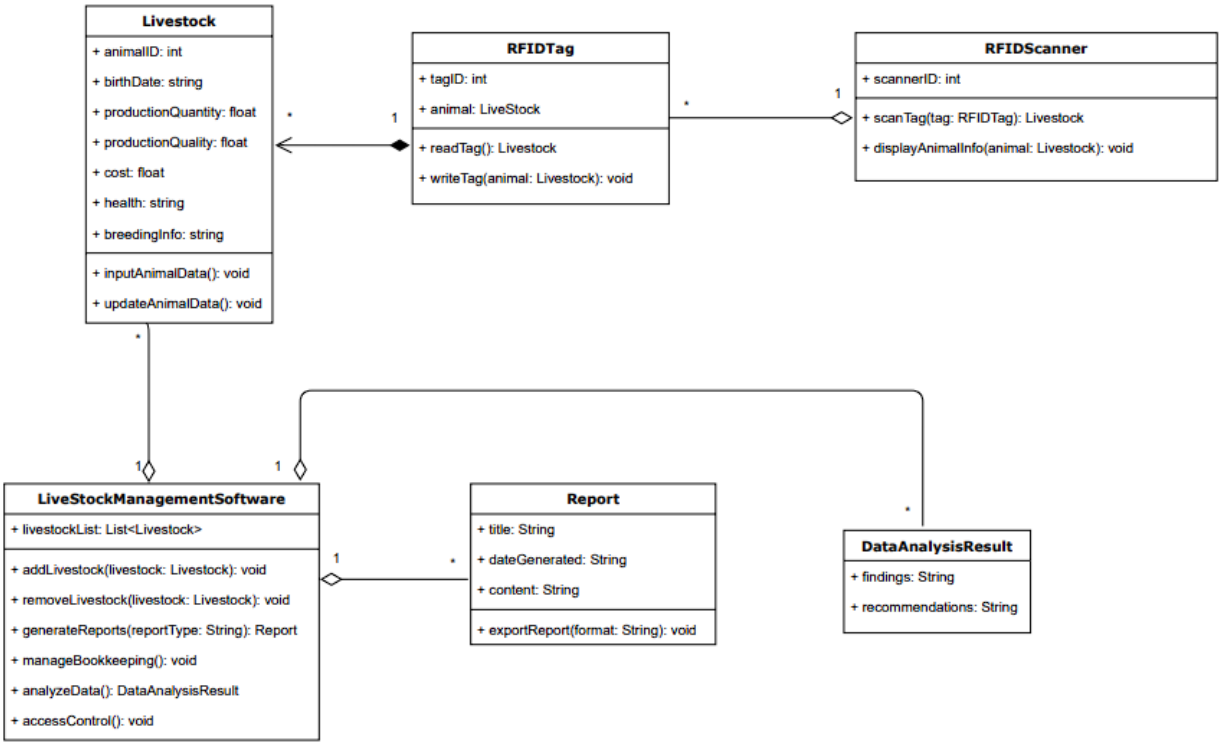


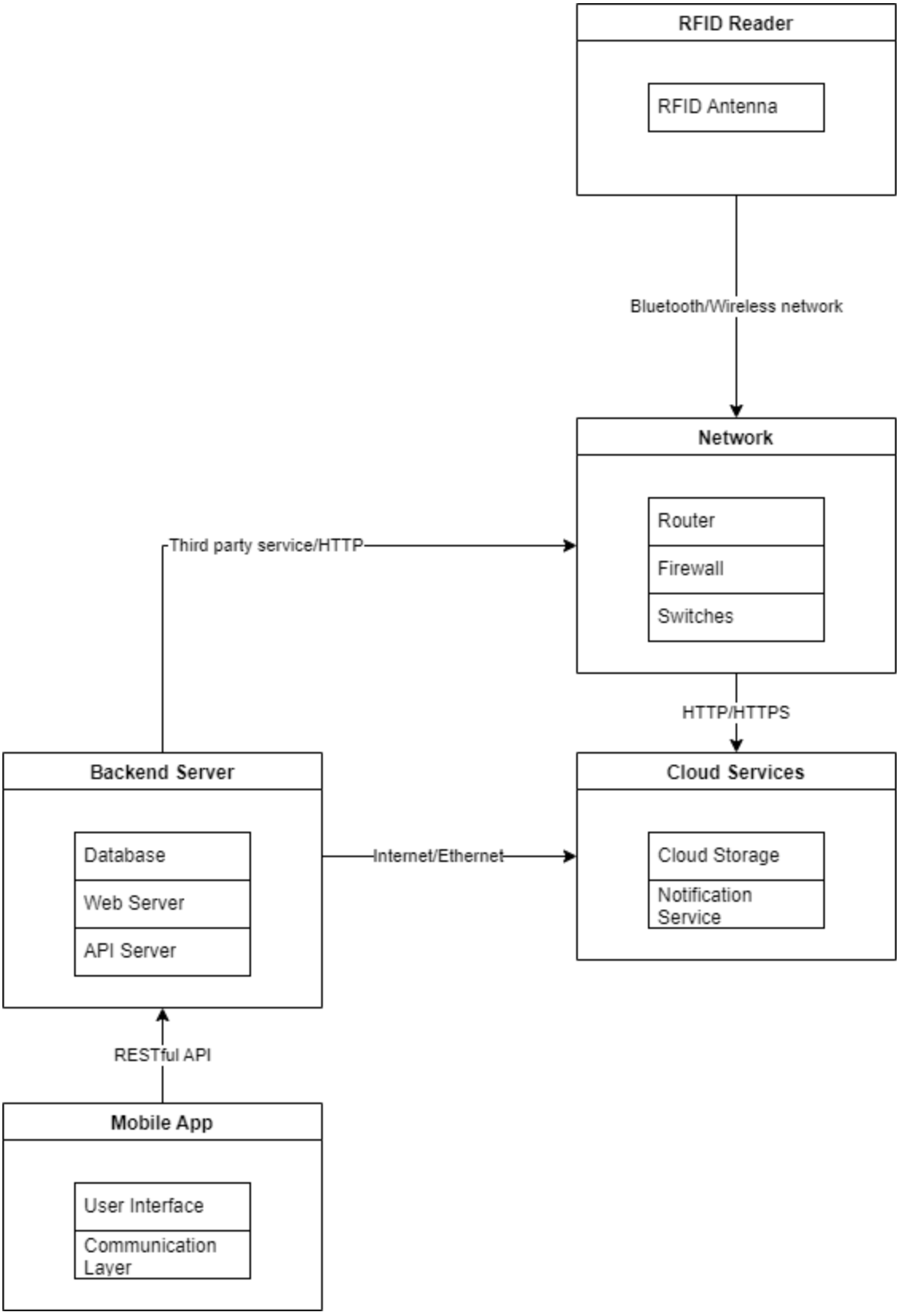
25g Application of Design Patterns

One design pattern that is being applied in the system is the Observer pattern. This pattern is used to keep track of changes in the state of certain objects and notify interested parties when these changes occur. In our system, the RFID reader can be considered the subject, and the animal tracking software can be considered the observer. When a new animal is detected by the RFID reader, the software is notified and can take appropriate actions.

Another design pattern being used is the Decorator pattern. This pattern allows for dynamic modification of an object's behavior without changing its original class. In our system, we could use the Decorator pattern to add additional functionality to the animal tracking software without modifying the original code. For example, we could create a decorator class that adds the ability to export animal tracking data to a different file format.

26 Final System Design





27 Object Design

27a Packages

Important:

+ com.company.rfid.data: This package could contain classes related to storing and managing the RFID animal tracking data, such as AnimalData and TrackingData.
+ com.company.rfid.reader: This package could contain classes related to interacting with the RFID readers, such as ReaderConnection and ReaderConfig.
+ com.company.rfid.ui: This package could contain classes related to the user interface, such as MainWindow and SettingsDialog.

27b Subsystem I

+RFID Reader Subsystem

Class: RFIDReader

Public methods:

void connect() : Connects to the RFID reader

void disconnect() : Disconnects from the RFID reader

String readTag() : Reads the tag data from the RFID reader

+Constraints:

The RFID reader must be connected before reading tags

27c Subsystem II

+Data Management Subsystem

Package: data

Class: Animal

Public methods:

int getId() : Returns the ID of the animal

void setId(int id) : Sets the ID of the animal

String getName() : Returns the name of the animal

void setName(String name) : Sets the name of the animal

String getSpecies() : Returns the species of the animal

void setSpecies(String species) : Sets the species of the animal

+Constraints:

The ID of the animal must be unique

The name and species of the animal must not be null or empty

27d etc.

+Reporting Subsystem

Package: report

Class: AnimalReportGenerator

Public methods:

void generateReport(List<Animal> animals) : Generates a report based on the list of animals

+Constraints:

The list of animals must not be null or empty

IV Project Issues

28 Open Issues

Data accuracy and reliability: With RFID technology, there may be instances where the data collected is inaccurate or unreliable due to tag malfunction, signal interference, or other factors. This can lead to incorrect animal tracking information, which could be a major issue for researchers and farmers relying on the data. To address this, the software could include validation checks and error correction algorithms to identify and correct any inaccuracies or inconsistencies in the data.

Compatibility with different RFID tag types: There are various types of RFID tags available in the market, and not all of them may be compatible with the software being developed. It is important to ensure that the software can read and interpret data from all types of RFID tags used in animal tracking. To address this, the software could be designed to support multiple RFID tag protocols and frequencies, ensuring that it can work with a wide range of tags.

Data privacy and security: Animal tracking data is sensitive information that needs to be protected from unauthorized access, theft, or misuse. The software should have robust security measures in place to ensure that the data is safe and secure. This could include encryption, access control, and auditing mechanisms to prevent data breaches and ensure data privacy.

Limited battery life of RFID tags: RFID tags have a limited battery life, which means that they will eventually need to be replaced or recharged. This can be a challenge for long-term animal tracking studies, as it may require frequent maintenance and replacement of tags. To address this, the software could include features to monitor the battery life of tags and provide alerts when they need to be replaced or recharged.

Signal interference and range limitations: RFID signals can be affected by various factors such as metal objects, water, and other electromagnetic signals. This can limit the range of the tags and affect the accuracy of the data collected. To address this, the software could include algorithms to filter out interference and improve the accuracy of the data, or use alternative technologies such as GPS in conjunction with RFID to improve the accuracy of the tracking information.

Cost and budget limitations: Developing a robust and feature-rich RFID animal tracking software can be an expensive undertaking. It is important to carefully manage the budget and resources to ensure that the software meets the needs of the stakeholders while staying within budget constraints. To address this, the software development process could be broken down into phases, with each phase delivering specific features and functionality while staying within budget constraints.

29 Off-the-Shelf Solutions

RFID Readers: There are many RFID readers available in the market that can be used in the new solution instead of developing a custom reader. For example, the Impinj Speedway reader is a popular choice that offers high performance and accuracy.

RFID Tags: Similar to RFID readers, there are many RFID tags available in the market that can be used in the new solution. For example, the Allflex Global cattle ear tag is a popular choice for tracking livestock.

Cloud-based data management: Instead of building a custom data management system, cloud-based solutions such as AWS IoT or Google Cloud IoT can be used to store and manage data.

Machine learning algorithms: There are many pre-existing machine learning algorithms that can be used for data analysis in the new solution. For example, a decision tree algorithm could be used to identify patterns in animal movement data.

Wireless network infrastructure: Instead of building a custom wireless network infrastructure, existing networks such as LoRaWAN or NB-IoT can be used to transmit data from the RFID readers to the cloud-based data management system.

User interface: Instead of building a custom user interface for the software, existing user interface frameworks such as React or Angular can be used to create an intuitive and user-friendly interface.

29a) Ready-Made Products:

RFID readers and antennas from various vendors (such as Impinj, Alien Technology, Zebra Technologies, etc.) that could be integrated into the system.

Animal tracking tags and collars from companies like Allflex, Datamars, and Shearwell Data.

29b) Reusable Components:

Libraries and toolkits for RFID data processing, such as the ThingMagic Mercury API, the Impinj Octane SDK, and the Alien Reader Protocol (LLRP) SDK.

Open source software for data management and analysis, such as Apache Hadoop, Apache Spark, and Elasticsearch.

29c) Products That Can Be Copied:

Previous animal tracking systems developed by the same development group, provided there are no legal or ethical issues that would prevent their reuse.

30 New Problems

30a Effects on the Current Environment

The new system could require additional training for employees to properly use it, causing a disruption in their daily routines.

The implementation of the system could lead to changes in workflow processes, potentially slowing down operations.

The use of RFID technology could raise concerns among employees regarding privacy and data security, affecting their job satisfaction.

30b Effects on the Installed Systems

The integration of the new system with existing hardware and software could cause compatibility issues.

The RFID readers may interfere with other radio signals in the environment, leading to reduced accuracy or relia*bility of the system.*

30c Potential User Problems

Users may have difficulty understanding or navigating the new system, leading to frustration and reduced productivity.

The system may not meet the specific needs or preferences of certain users, leading to resistance or reluctance to use it.

30d Limitations in the Anticipated Implementation Environment That May Inhibit the New Product

The use of RFID technology may be limited in outdoor environments with extreme weather conditions, affecting the system's performance.

The lack of reliable power or network connectivity in certain locations could limit the effectiveness of the system.

30e Follow-Up Problems

The maintenance and upkeep of the system could require additional resources and support.

Changes in regulations or standards related to animal tracking could require updates or modifications to the system.

31 Migration to the New Product

31a Requirements for Migration to the New Product

The new system should be able to import data from the previous tracking system.

The migration should be done in a way that does not cause data loss or corruption.

The migration process should not disrupt the normal functioning of the tracking system.

31b Data That Has to Be Modified or Translated for the New System

The data format used in the previous tracking system needs to be converted to the format compatible with the new system.

The existing animal identification numbers need to be mapped to the new system's identification numbers.

The data on the animal's past movements and health records need to be transferred to the new system.

32 Risks

The risk of technical failure or malfunction of the RFID readers, leading to inaccurate tracking of animal movements.

The risk of data security breaches or unauthorized access to sensitive information in the system.

The risk of low adoption or acceptance of the system by farmers or other stakeholders.

There may not be enough skilled personnel available to implement and maintain the new system.

The cost of implementing the new system may exceed the available budget, causing the project to be cancelled or delayed.

33 Costs

The cost of purchasing and installing RFID readers and related hardware.This servers, network infrastructure, and any necessary software licenses.

The cost of developing and maintaining the software system, including ongoing updates and support.

The cost of hiring and training new personnel, as well as the cost of existing staff members' time spent on the project.

The cost of training staff and stakeholders on the new system. The potential revenue that could have been generated if resources were allocated to other projects.

34 Waiting Room

Integration with other existing animal management systems used by farmers.

Expansion to track other types of animals beyond the initial focus on cattle.

There may be additional functionality that would be useful, but is not essential for the current release.

35 Ideas for Solutions

Utilizing a cloud-based system for more efficient and scalable data management.

Integrating machine learning algorithms to improve the accuracy of animal tracking.

Developing a mobile application for easy access to tracking data on-the-go.

36 Project Retrospective

Conduct a survey with real stakeholders to gather feedback on the effectiveness of the new system.

Analyze the development process to identify areas of improvement for future projects.

Document lessons learned and best practices for future reference.

Communication could be improved by having regular status updates and meetings.

Conduct an early access test if possible

V Glossary

Animal tracking: The process of monitoring and recording the movements and behaviors of animals over time, often using RFID technology.

Antenna: A device that sends or receives radio signals, often used in conjunction with RFID readers and tags.

Data logging: The process of recording data over time, often used in animal tracking to collect and analyze information about animal behavior.

GPS: Global Positioning System. A network of satellites that provide geolocation and time information to GPS receivers.

Cloud services: Online computing services that provide scalable and flexible access to computing resources, often used to store and process large amounts of data.

Backend server: A server that provides centralized processing and storage for a software application, often responsible for managing data and application logic.

Mobile app: A software application designed to run on mobile devices such as

smartphones or tablets, often used to provide a user interface for accessing and interacting with software systems.

VI References / Bibliography

[1] Robertson and Robertson, Mastering the Requirements Process.

[2] A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts, Ninth ed., Wiley, 2013.

[3] J. Bell, "Underwater Archaeological Survey Report Template: A Sample Document for Generating Consistent Professional Reports," Underwater Archaeological Society of Chicago, Chicago, 2012.

[4] M. Fowler, UML Distilled, Third Edition, Boston: Pearson Education, 2004.