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AGREEMO: DEVELOPMENT OF AN ANDROID APPLICATION FOR SOLAR-POWERED HYDROPONICS GREENHOUSE WITH PLANT MONITORING AND AUTOMATIC NUTRIENT CONTROLLER

A Capstone Project Documentation
Presented to
The College of Information Technology
QUEZON CITY UNIVERSITY

In Partial Fulfillment
of the Requirements for the Degree
BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

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APPROVAL SHEET

In partial fulfillment of the requirements for the degree **BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY**, a Capstone project entitled **AGREEMO: Development of an Android Application for Solar-Powered Hydroponics Greenhouse with Plant Monitoring and Automatic Nutrient Controller**, has been prepared and submitted by "Aguilar, Jay Angelo V., Arca, Mark Gervic, Aropon P., Mark James B., Cabaya, Dane Justine C., Cabrera, Rachel Jhoy L., Canales, Allyson E., Castromayor, Jay Boy A., Delotavo, Giebert R., Delos Santos, Cris Christian D., Lagleva, Ashley Nicole R., Libardo, Noel Jr. R., Lladones. Leomar C., Mojares, Ashley Jade T., Pecoro, Kathleen Mae A., Tabios, Maria Alesa S., and Tiro, Julito III, T." who are hereby recommended for project presentation.

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DEDICATION

In recognition of the dedication shown by Group 2 (SBIT-4A, 2024-2025), this capstone project is dedicated to the significant contributors.

This project is dedicated to The Sunnyville Community Model Farm of Pasong Tamo. For their invaluable partnership and the opportunity to develop a prototype sustainable greenhouse aimed at enhancing plant monitoring in their urban farm. The Proponents extend their sincere gratitude for their unwavering support and commitment to community development.

This project is dedicated to The Proponents' Parents. For their immeasurable support, both mentally and financially, which enabled the proponents to pursue and complete this endeavor. The encouragement and belief in their abilities have been instrumental in the proponents' success.

The Proponents hope that this project will serve as a valuable resource and inspiration for future Quezon City University IT students embarking on their own system development journeys, and that it will contribute positively to The Sunnyville Community Model Farm and the wider community.

ACKNOWLEDGMENT

The proponents of this capstone project extend their deepest and most sincere gratitude to the following individuals and entities who have contributed significantly to its realization:

First and foremost, The Proponents offer their profound thanks to the Divine, whose unwavering guidance, strength, knowledge, and wisdom have been the cornerstone of their journey.

The Proponents are immensely grateful to their Capstone Project advisor, Mrs. Norilyn C. Sindanum, for her invaluable assistance, insightful guidance, and unwavering encouragement. Her dedication and support inspired the proponents to strive for excellence.

The Proponents heartfelt appreciation goes to their parents, who provided the essential foundation for this study. Their consistent financial and moral support was crucial to the proponent's success.

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EXECUTIVE SUMMARY

Title : **AGREEMO: Development of an Android Application for Solar-Powered Hydroponics Greenhouse with Plant Monitoring and Automatic Nutrient Controller**

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Degree : **Bachelor of Science in Information Technology**

Date Completed: **2025**

Keywords : **Hydroponics, Greenhouse, Solar-Powered Hydroponic, Greenhouse, Android Application, Plant Monitoring, Automatic Nutrient Controller**

EXECUTIVE SUMMARY

The capstone project titled "AGREEMO: Development of an Android Application for Solar-Powered Hydroponics Greenhouse with Plant Monitoring and Automatic Nutrient Controller" seeks to address the inefficiencies of traditional hydroponic way of farming practices through the integration of modern technology. The project was developed in partnership with the Sunnyville Community Model Farm, an urban farming initiative in Quezon City that currently relies on manual processes for monitoring water quality, plant growth, and environmental conditions within its greenhouse. These manual methods are slow ,error prone, and lack precision—factors that can negatively impact plant health and yield. To solve these challenges, the researchers designed a smart, solar-powered hydroponics greenhouse system powered by Internet of Things (IoT) devices, which is capable of automatically monitoring and regulating pH level, nutrient concentration (TDS), humidity, water temperature, and ambient greenhouse conditions.

The system is operated through a user-friendly Android application tailored for farmers and a web-based dashboard for farm managers. The mobile app allows farmers to receive real-time updates, control misting and nutrient dispensing systems, and track lettuce growth using AI-powered image processing. Meanwhile, the web application consolidates reports on harvested and rejected crops, user activity, and hardware status. The system was developed using Agile methodology and employed ESP32 microcontrollers, a range of analog and digital sensors, and solar panels to ensure its sustainability. Testing and evaluation were conducted with 28 farmers and one farm manager from the Sunnyville Farm, using Likert-scale surveys and descriptive statistics to assess the system’s performance based on the ISO 25010 software quality standard. Results showed high levels of user satisfaction across five key dimensions: functionality, compatibility, usability, reliability, and security. Notably, the automation features contributed significantly to improved efficiency, minimized operational errors, and optimized the growing environment for lettuce cultivation.

Key findings from the study indicate that AGREEMO not only reduces the dependency on manual labor but also enhances productivity and promotes sustainable agricultural practices by utilizing renewable energy and rainwater harvesting systems. Farmers reported increased crop yield and quality, as well as greater ease in managing daily tasks within the greenhouse. Despite its successes, the system has limitations, including its dependence on a stable internet connection and limited compatibility with Android devices below version 11. The AI component, while functional, is currently limited to identifying lettuce growth stages and does not yet have the capability to detect plant diseases or pest infestations. Based on these findings, the researchers recommend expanding device compatibility, improving AI capabilities, enhancing power

backup with larger battery storage, and providing farmer training on digital tools to ensure widespread adoption.

In conclusion, the AGREEMO project offers an adaptable and effective solution to the pressing problem faced by urban farmers. By leveraging IoT technology, solar energy, and real-time data analytics, it presents a forward-thinking approach to precision agriculture that is not only technologically sound but also socially and environmentally responsible. This project serves as a benchmark for future innovations in smart farming and underscores the transformative potential of IT solutions in addressing real-world agricultural problems.

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PROJECT CONTEXT AND BACKGROUND

1.1 Introduction

In the modern era of technology, innovation offers numerous solutions to alleviate the challenges of Greenhouse farming. Greenhouses act as man-made incubation sites for plants, overcoming agricultural boundaries, including the ability to grow seasonal and temperature-sensitive plants by using traditional and innovative planting. Hydroponics is one innovative way of planting, it's a process of nurturing plants with water and nutrient solutions to deliver essential elements for plant growth.

Hydroponics mitigates water loss, which reduces runoff and the need for pesticides and herbicides caused by microorganisms. It's also great in urban farming because it maximizes space by vertically stacking the plants, which conserves resources and increases the production of crops. However, hydroponics still has its disadvantages. One of its many disadvantages is its vulnerability to power outages because it's reliant on electricity and primarily uses electronic instruments to provide water flow throughout the system. Hydroponics requires constant monitoring of water conditions, which are pH level and nutrients. Many commercial hydroponic greenhouses use automated systems that monitor and control water conditions, reducing the manual work for farmers. However, it is lso important to mention that the systems available in the market are often too expensive, thus some farms are still relying on manual monitoring.

The project’s beneficiary and prototype model are based on Sunnyville Community Model Farm’s hydroponic greenhouse. The farm’s hydroponic greenhouse heavily relies on manual monitoring of water conditions and plant growth, which is slow and error prone. Additionally, Sunnyville has no ways to mitigate heat stress for plants and they don’t monitor the pH level of the water used for irrigation. Based on their processes and observed lack thereof, the researchers’ objective is to create an Android application that utilizes sustainable resources, such as rainwater and solar panels for an automated hydroponic greenhouse. The automated hydroponic greenhouse will monitor and control the water conditions and momentarily reduce heat inside the greenhouse with additional functions, such as plant growth monitoring.

1.2 Background of the Study

The Sunnyville Community Model Farm is an urban farm located in Barangay Pasong Tamo Quezon City. They have greenhouses that nurture several types of leafy vegetables, such as Spinach, Lettuce, Kangkong, etc. They use natural resources for their irrigation, such as rainwater gathered from their well and pond. However, it is worth mentioning that they also use tap water from unsealed containers that are resting for 2-3 days; this process helps evaporate the chlorine naturally. For fertilizers, they use fish amino acids and composite.

Their hydroponic greenhouse primarily consists of lettuces. They use irrigation from an unsealed reservoir where it catches rainwater. The water collected is then added to 2 ml of each solution (A and B) per 1 liter of water, these solutions are the necessary nutrition for the plants to grow. Solution A is rich with macronutrients which are NPK (Nitrogen, Phosphorus, and Potassium) while Solution B is rich with micronutrients such as Manganese, Iron, Boron, Copper, Zinc, Chlorine, and Molybdenum. They manually monitor the EC level of the reservoir every day to see if the water is at its optimal level of 500 ppm. If the level is under the optimal, the farmers will add solutions to the water.

The greenhouse is made of metal as its foundation and garden nets as its covering materials to protect the lettuces from animals, insects, and intense weather conditions like extreme rain, winds, and heat. The type of greenhouse is a Gothic Arch Greenhouse, due to its tear-shaped roof, which helps with natural ventilation and allows sunlight to evenly disperse throughout the greenhouse (Li et al., 2024). However, due to the urban heat island, the greenhouse reaches 30°C during peak sun hour, which is not optimal for lettuces. The farmers don't have a way to mitigate heat stress for the plants. The optimal temperature of the water for lettuce is 20.04°C to 26.32°C (Li et al., 2024), while the temperature inside the greenhouse is between 15°C to 21°C (Nemali, K. 2021).

Based on their processes, the researchers' objective is to create an Android application that monitors and automates hydroponic farming processes to help minimize manual processing and human error for the farmers. The researchers' way to show possibility is by creating a prototype of Sunnyville Community Model Farm's hydroponic greenhouse to perform the commands from the Android application. The main function of the proposed system is to control and monitor water conditions, such as the TDS level and temperature of the irrigation and misting reservoir. And monitor and momentarily decrease the temperature inside the greenhouse by using a misting.

1.3 Theoretical Framework

Socio-Technical System Theory was developed by Eric Trist and Kenneth Bamforth in 1950s at the Tavistock Institute (Geraghty, 2024) and has been continued worldwide basis by figures such as Albert Cherns, Chris Clegg, Harold Leavitt, Mary Parker Follet, and many others. When social aspect and technical aspect are united, they are a interdependent components of non-linear system and complex system, hence Socio-Technical System Theory are improved and interpreted (University of Leeds Business School, 2022).

Internet of Things (IoT) popularity technologies improved the sustainability and productivity of agriculture by adapting advanced technology called Smart Farming through interconnecting sensors, devices, and data anayltics. Transformative role of IoT is highlighted in the study, in modern agriculture, emphasizing its decision making, real-time monitoring support, and resource optimization. Internet of Things (IoT) applications in agriculture include automated systems that encompass the processes in irrigation, plant health tracking, soil, and crop monitoring, showcasing its potential to enhance efficiency and sustainability (Duguma and Bai, 2024). To fully utilize IoT's influence in smart farming, Socio-Technical System (STS) provides a perspective on how technology is effectively integrated with people and the organization. In instance, IoT systems interact with farming processes, infrastructure, and human operators, reinforcing the need for a socio-technical approach to designing and implementing these technologies.

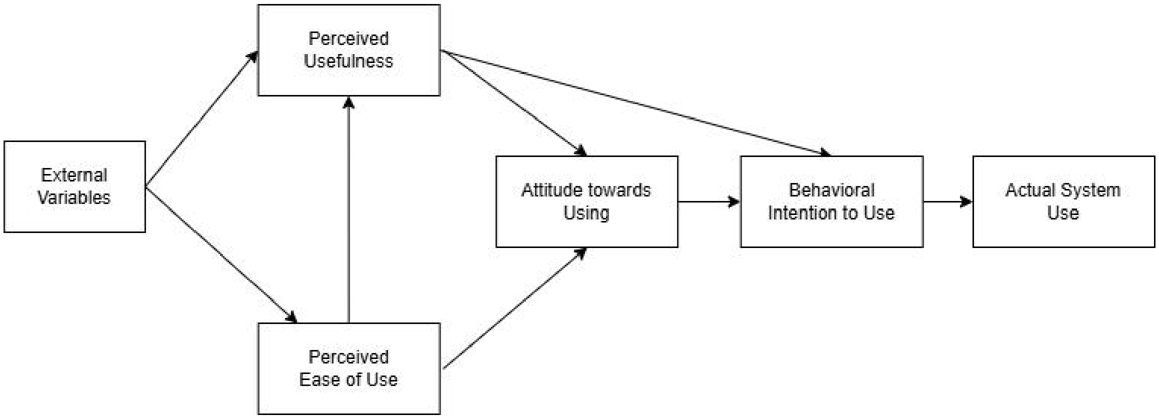

Figure 1.3. The Technology Acceptance Model

Socio-Technical System Theory was developed by Eric Trist and Kenneth Bamforth in 1950s at the Tavistock Institute (Geraghty, 2024) and has been continued worldwide basis by figures such as Albert Cherns, Chris Clegg, Harold Leavitt, Mary Parker Follet, and many others. When social aspect and technical aspect are united, they are a interdependent components of non-linear system and complex system, hence Socio-Technical System Theory are improved and interpreted (University of Leeds Business School, 2022).

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1.4 Conceptual Framework

AGREEMO is an application developed to assist people (Farmers and Farmer Manager) of Sunnyville Farm Community Model in automating some of their manual processes and monitoring lettuce growth within their Hydroponic Greenhouse by integrating Internet of Things. To understand the key variables:

Independent variables (Manual Hydroponics vs Automated Hydroponics), Dependent Variables (Lettuce Growth & Yield and System Usability & Adoption), and Intervening Variables (User interaction and Internet connectivity) supported by Socio-Technical System Theory, hence these variable's relationships are analyzed using the Technology Acceptance Model that guided the study's conceptual framework.

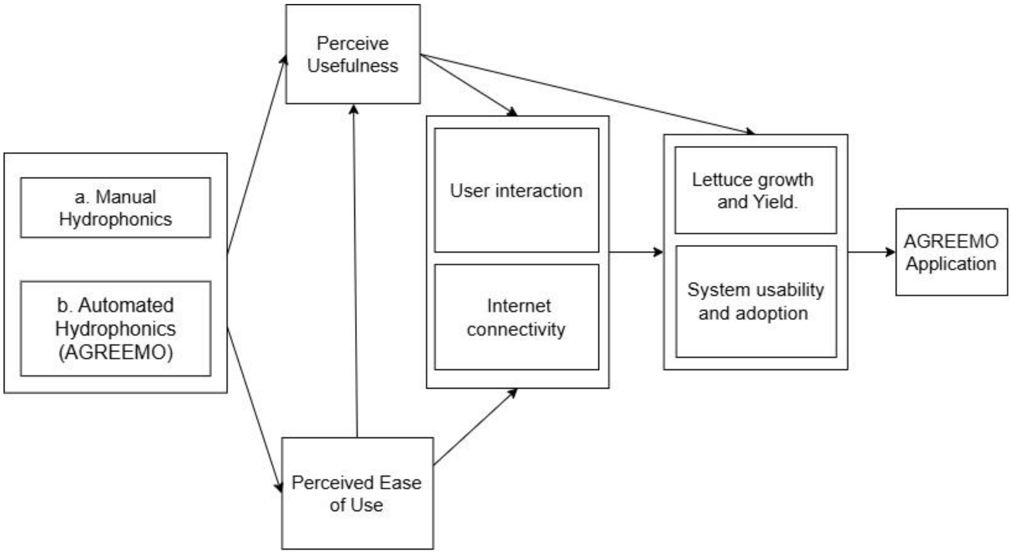

Figure 1.4. Conceptual Framework

Processes of AGREEMO Application are based on the Manual Hydroponics of Sunnyville Community Model Farm; thus, the processes in the system are Internet of Things (IoT)-based: measuring pH, water quality, humidity, water levels, and temperature are done through readings of sensors. Hydroponic Greenhouse's rainwater collection and solar panel are a solar-powered infrastructure.

AGREEMO is user-friendly and internet-based for a real-time monitoring to notify farmers on time. Farm Manager accessed the Website Application it monitors the activities of Farmers, while the Farmer can only access the Android Application for monitoring lettuce growth.

Under automation, Height and Width, and production of Lettuce will improve through precise control of environmental conditions and nutrients. The system usability and adoption are evaluated through ISO 25010 criteria. AGREEMO's overall conceptual framework encompasses the flow of processes and functionality of the system ensuring users' satisfaction.

1.5 Objective of the Study

1.5.1 General Objective

The general objective was to develop a solar-powered hydroponics greenhouse, modeled after the Sunnyville Community Model Farm. Integrated with an Android application that features plant monitoring and an automatic nutrient controller for lettuce cultivation.

1.5.2 Specific Objectives

1. Determine the problems encountered by urban farms in hydroponic greenhouses.

2. Develop an automated water cooling system in the hydroponic and misting reservoirs to minimize heat inside the greenhouse.

3. Design a solar-powered hydroponic greenhouse prototype specifically tailored for lettuce (Lactuca sativa) cultivation, modeled after Sunnyville Community Model Farm. Incorporating rainwater drainage and solar panels to enhance greenhouse's ability to operate independently.

4. Develop an Android application that allows farmers to remotely monitor plant growth, and control greenhouse functions in real-time, such as the water cooling system, misting system, and nutrient-controller (pH Solutions and Solution A & B). To Ensure optimal level of water quality and environmental conditions and reduce manual check-ups.

5. Develop a website application for farm managers to manage users, monitor system performance, and generate reports through data visualization for easy summarization.

6. Evaluate the Android Application that follows ISO 25010 for system quality to ensure the application meets its requirements based on:

- **Functionality:** This evaluates the extent of completeness, correctness, and appropriateness of system functions.
- **Compatibility:** This measures how compatible the system is with other platforms/devices, and its co-existence and Interoperability.
- **Usability:** This evaluates the extent of Appropriateness Recognition, Learnability, Operability, and aesthetics of the User interface, and Accessibility of the Application.

- **Reliability:** This measures how reliable the application is when it is used daily and dependable on the system to hardware.
- **Security:** This evaluates the extent of Authorization and Confidentiality of users' data.

1.6 Scope and Delimitation

Scope

1. The water cooling system and misting system will be activated once the temperature of the greenhouse reaches 30°C. The water cooling system for the irrigation reservoir will deactivate once the water reaches 21°C, while the cooling system in the misting reservoir and misting system will turn off if the temperature inside the greenhouse is below 30°C.

2. The prototype integrates a solar panel system connected to a rechargeable battery that powers essential components such as the ESP32 microcontroller, light lamps, misting, and nutrient dispensing systems.

3. A rainwater collection system is included, wherein water is directed through pipes into a storage reservoir, emphasizing sustainability and urban farm adaptability.

4. The system is embedded with sensors (pH, TDS, temperature, humidity, and ultrasonic) to monitor greenhouse conditions and automated controls,

to regulate the nutrient concentration, water quality, temperature, humidity inside the greenhouse, and Liquid levels in irrigation and nutrient tanks.

5. Cooling mechanisms (misting and exhaust fans) activate when the temperature exceeds the optimal range and deactivate once ideal levels are restored.

6. The greenhouse is optimized for lettuce growth, maintaining the pH levels between 5.5 and 6.5; TDS between 560 ppm and 840 ppm, Temperature range of 15°C to 21°C, and Humidity between 40% and 60%.

7. Water temperature is monitored and used as a trigger for misting and cooling features to reduce heat stress on plants.

8. Nutrient absorption is measured every two hours by comparing historical and latest sensor readings, assisting farmers in adjusting solution concentrations.

9. The greenhouse features vertical space optimization for urban settings and includes physical protections such as netted covers against pests and extreme weather.

10. The Android app connects wirelessly with the greenhouse system via Wi-Fi, displaying real-time data collected from sensors.

11. Ultrasonic sensors track water levels in irrigation and solution tanks; notifications are sent when critical refill levels are reached.

12. The app includes manual controls for activating misting and exhaust systems and dispensing pH up/down and nutrient solutions A & B.

13. Farmers are notified of harvest readiness through an AI image recognition module, which uses YOLOv8 for segmentation, OpenCV and NumPy for processing, and OneSignal for notifications.

14. The app also allows inventory input by milliliter, tailored for managing liquid resources such as nutrient and pH solutions.

15. The web platform aggregates report from farmer inputs, including the number of harvested and rejected lettuces, Inventory usage, Greenhouse hardware status, and Farmer activity logs.

16. Data is presented using tables and graphs for quick interpretation and decision-making.

17. Farm Managers have access to account management tools for farmers, including storing user details and account activation links.

18. The web application gives a centralized interface for monitoring the system's operational health and performance over time.

19. The evaluation used is a 5-point Likert scale evaluation administered to Agriculturists, Farmers Managers, and Software and hardware experts.

20. Evaluation was based on ISO 25010 attributes Functionality: Correctness and completeness of app features; Compatibility: Device and system interoperability (focused on Android 11 and up); Usability: Ease of learning and operation; Reliability: Consistency during repeated use and responsiveness to sensor data; and Security: User-level access control and data confidentiality.

21. Statistical treatment was applied using weighted mean to interpret user satisfaction and system effectiveness.

Delimitation

1. The hydroponics greenhouse prototype is specifically created for urban farming applications, as it addresses challenges unique to urban environments, such as managing heat. Its design and functionalities are

not intended to address agricultural challenges in rural settings or other climate conditions.

2. The solar panel and battery will not support all the operations inside the greenhouse; direct AC connection is still necessary. The power generated by solar power and the amount of power charged in the battery will not be accessible in the android application and website application, manual monitoring is necessary.

3. The Android application is compatible only with devices running Android 11 to Android 15.

4. The automation and real-time data monitoring require a stable internet connection.

5. The system does not automatically dilute the TDS level when it exceeds the optimal range but provides notifications for farmers to manually dilute the water.

6. The temperature and humidity level inside the greenhouse can be temporarily achieved at the optimal level using water cooling, misting, and exhaust fans.

7. All optimal levels for automation processes, such as nutrient solution dispensing, water cooling, and greenhouse temperature and humidity

control, must be manually configured through hardware. Farmers can manually adjust these settings as needed.

8. The AI used for lettuce growth monitoring is only 78% accurate and has no active learning capability. Therefore, it cannot identify lettuces with diseases and detect pests.

1.7 Significance of the Study

The AGREEMO Android Application plant monitoring and automatic nutrient controller is significant in modernizing agricultural practices such as controlled environments. The capstone project brings significant advancements in areas for Students, Future Researchers, and Sunnyville Community Model Farm of Barangay Pasong Tamo.

For Students

This project serves as an educational model that provides learning on developing a monitoring system with Automated Nutrient Controller for water-based plants by integrating hardware such as sensors, solar panel, Arduino Board, and ESP32 as well as designing a prototype of a Hydroponic Greenhouse. This project provides guidance on utilizing data gathered from plants to utilize it to program with Arduino Board and ESP32 for automating the functions of manual processes of a Hydroponic Greenhouse.

For Future Researchers

This project serves as a reliable source of study intended for analyzing data and determining the principles of the Solar-Powered Hydroponic greenhouse, Plant Monitoring with sustainable resources, and smart farming technology. AGREEMO integrates a Internet of Things (IoT) to serves as an insight into improving the help of plants, such as Arduino Board, ESP32 microcontroller chip, ESP32 camera, temperature, pH, Humidity, Ultrasonic, and Total Dissolved Solid (TDS) sensors.

For Sunnyville Community Model Farm of Barangay Pasong Tamo

This project promotes agricultural practices by integrating eco-friendly technologies to reduce the reliance on non-renewable sources using renewable energy, water reclamation, and automated systems. It aids in minimizing traditional processes and lowering the cost of water and electricity billing with rainwater sustainability and solar panels as a source of energy to power the Hydroponics Greenhouse. Cultivating, tracking the growth, measuring the plants' nutrients, and adjusting the temperature are decisively effective with AGREEMO, making it efficient.

1.8 Definition of Terms

Arduino Board. A microcontroller. The robot's brain is housed in this little computer. It can be configured to regulate how switches, motors, buttons, lights, and other electronic components interact.

CTO. Represents chlorine, taste, and odor and is a type of compressed activated carbon used for fine-grained filtration. CTO filters are typically more effective than GAC filters at removing a range of pollutants from water.

Fogger. Help control humidity and establish the perfect environment for plant growth. In essence, fogging is a visible cloud of water droplets floating in the atmosphere that cools and hydrates the growing environment.

Greenhouse. Enclosed structures that precisely control temperature, humidity, and lighting to grow plants.

Hydroponics. A technique that uses a water-based fertilizer solution to grow plants without soil.

Hydroponics Greenhouse. A greenhouse that grows plants without the use of soil. It uses water and nutrient solutions to provide nutrients for the plant.

Man-made. Something that is created or manufactured by humans rather than occurring naturally. It describes objects, structures, or concepts that are the result of human ingenuity and diligence.

Misting. Also known as mist, dissipates quickly to chill the greenhouse and keep the humidity level steady without allowing too much moisture to build up.

Power Supply. Transforms incoming electrical power—typically from an AC outlet—into the precise voltage, current, and frequency required to run a computer or other equipment.

PP. Symbolizes polypropylene, a durable and adaptable filtration material commonly found in industrial fluids. PP membrane filters are used to remove bacteria and particulates from liquids in the food and beverage, pharmaceutical, and water treatment industries.

Rainwater Harvesting. Gathering and storing rainwater for use in irrigation and other uses.

Solar-Powered. Driven by solar heat radiation that is transformed into electrical power

User Levels. Regulated access to diverse data and functionalities is made possible by the Android app's several permissions and access levels.

Water Purifier. A device that removes impurities from water to improve its quality for hydroponic systems.

Operational & Technical Definitions

Admin. An elevated-privilege user who oversees and manages a system's configuration, maintenance, and security. They have more authority to do tasks like user management, system configuration, and troubleshooting in order to provide the highest level of system security and efficiency.

Android Application. An Android smartphone app that monitors and controls various hydroponic greenhouse components.

ESP-32. Is used in hydroponic systems to keep an eye on and regulate a number of variables, including temperature, pH, fertilizer levels, and water level. By collecting information from sensors and managing actuators to maximize growing conditions, it serves as the central processing unit.

Nutrient Controller. Is a tool used in aquaponics and hydroponics that automates the process of keeping the water solution's nutrient levels at ideal levels.

PAGASA. PAGASA which stands for The Philippine Atmospheric, Geophysical and Astronomical Services Administration is a federal agency that provides weather forecasts, warnings, and other information to assist protect people and property from natural disasters.

pH level. This represents the acidity or alkalinity of a liquid solutions.

Self-sufficiency. A hydroponic greenhouse's ability to produce its own electricity (using solar power) and water (using rainwater collection) to lessen reliance on external sources.

Sustainability. A hydroponic greenhouse's ability to operate sustainably, reducing waste and conserving resources.

TDS (Total Dissolved Solids). An Arduino-powered sensor is frequently used in hydroponics, aquariums, and water purification since it can measure the concentration of dissolved minerals, salts, and other substances in water, giving an indication of its quality.

Urban Farming. Growing plants in cities, frequently in cramped environments like inside or rooftops.

CHAPTER 2

REVIEW OF RELATED LITERATURE AND SYSTEM

2.1. Related Literature

2.1.1 Local Literature

Overview of Greenhouses

Smart Farming method is used by Hydroponics a water-based through nutrient solutions along with the advantages of controlling the conditions of nutrient levels, pH, and environmental ambience like humidity, light, and temperature by integrating sensors an Internet of Things based.

In an article by Macayana et al. (2023), Smart Hydroponics consists of three sensor sets. First is the Macro Environment sensor, which measures the outside growing condition of the environment. All data gathered from sensors provide inputs for maintaining conditions (air pressure, air temperature, relative humidity, and illuminance) in a grow room. Second is the Microenvironment sensor for plant growth; it supports a variety of sensors (analog electrical conductivity, analog acidity, illuminance and gas). Third is the water sensor; it focuses on measuring water-related factors (water temperature, acidity (pH), and electric conductivity).

Also, in an article of Macayana et al. (2023), Smart Hydroponic Greenhouse system enhances traditional hydroponics with advanced technologies, offering enefits such as improved water efficiency through recirculation and minimized evaporation, reduced space requirements suitable for urban settings, consistent year-round production unaffected by external weather, and remote monitoring and control of environmental conditions for real-time adjustments. Furthermore, the system leverages sensor data for data-driven decision-making, aiding farmers in optimizing yields and resource management. Nevertheless, the modernization introduces challenges including the complexity of the technology hindering accessibility for all farmers, the necessity for technical expertise in setup and upkeep, potential risks to crop health from technological malfunctions or power failures, data security vulnerabilities inherent in IoT-based systems, limitations in the types of crops that can be grown, and the ongoing need for system maintenance to ensure smooth operation.

As per Sorrilla et al. (2023), describe a technique that uses water from a hydroponic plant to irrigate epiphytic plants in order to preserve water. The development of a solar-powered hydroponic greenhouse system that can optimize plant growth using some sensors to monitor the environmental parameters which include temperature, humidity, pH, and nutrient levels is in line with this idea. Trying to enhance resource efficiency and sustainability in urban agriculture is the main goal of both study and literature. Sorrilla et al. (2023) highlight the use of renewable energy such as solar power, as key to the component of the proposed system for powering the hydroponic greenhouse.

Hydroponics

A study from Bendanillo (2023), investigates the potential applications of hydroponics construction and farming technology to advance urban sustainability. The literature indicates that hydroponic systems can reduce reliance on traditional farming methods while producing vegetables year-round. It also emphasizes how important it is to use controlled environments, like greenhouses, and integrate technologies, like submersible pumps, to move nutrients around. The project's goal is to create an Android application for monitoring a solar-powered hydroponic greenhouse; therefore, this assessment is quite pertinent. Like the findings in the literature, the initiative aims to maximize environmental management using temperature, humidity, pH, and TDS sensors to guarantee ideal growing conditions for crops like lettuce and snow cabbage. The evaluation also addresses the use of greenhouses for plant protection, which is closely related to the project's objective of establishing a sustainable, regulated environment.

According to Antonio et al. (2021). This study defines hydroponics as a method of growing plants without soil by using mineral nutrient solutions in a water solvent. The researchers aimed to design a smart hydroponics system suitable for limited urban spaces in the Philippines, where traditional farming is often constrained. The paper emphasizes the sustainability and practicality of hydroponics in urban Filipino communities and educational institutions.

Automated Hydroponic Greenhouses

According to Velazquez-Gonzalez et al. (2022), hydroponics is a soilless agricultural technique that may be used to boost food production in both urban and rural regions. With the world's population increasing and land resources decreasing, hydroponics provide a resource-efficient method of growing crops in constrained areas. However, small-scale hydroponics use presents difficulties, particularly in rural locations with inadequate equipment.

The proposed project, which involves creating an Android application for a solar-powered hydroponic greenhouse, had a close connection to the study. Both emphasize using technology to enhance small-scale farming. The focus of the review on the use of IoT for environmental monitoring and control, including electrical conductivity (EC), pH, humidity, and temperature, is directly relevant to the suggested Android app. These technologies can be used by the app to assist farmers in efficiently managing their hydroponic systems.

Velazquez-Gonzalez et al.'s review from 2022 offers important insights on how technology might enhance hydroponic farming on a small scale. These concepts are incorporated into the proposed Android application, which aims to increase the sustainability, accessibility, and efficiency of hydroponic farming.

Hydroponic Lettuce Cultivation

According to James Tababa (2023), controlling the pH of the soil is crucial for productive farming methods. He explains that the availability of essential nutrients, such as phosphorus, potassium, calcium, and magnesium, can be severely limited in acidic soils, while micronutrients like iron, manganese, and zinc may be less accessible in highly alkaline soils. The Philippines' Bureau of Soils and Water Management (BSWM) responded by creating the Rapid Soil Test Kit (RST), a portable and reasonably priced instrument that enables farmers and agricultural technicians to rapidly determine the pH of soil in the field. Finding nutrient imbalances that can reduce crop productivity—particularly in crops like rice—is made easier with the help of this tool. The article also describes several techniques for modifying the pH of soil, such as using wood ash and lime to raise the pH and sulfur, aluminum sulfate, and ferrous sulfate to lower it. Tababa (2023) asserts that enhancing crop performance and optimizing yields depend on properly controlling soil pH.

An analysis of Elegado (2022) evaluated the new technologies changing hydroponic greenhouse systems, with soft sensors such as Arduino to improve decision-making and automate procedures like nutrient distribution. These innovations are relevant and can be crucial for getting beyond the drawbacks of conventional hydroponic systems and for improving farming's sustainability and efficiency. Elegado study findings are highly relevant to the proposed project for Android application system and solar-powered hydroponic greenhouse. The project's goals of providing real-time monitoring and automatic nutrition regulation are also in line with the use of sensors to track important environmental parameters. Using solar energy as a portable power source for the project, it aligns with Elegado's need for more environmentally friendly farming methods. To grow and maximize plant health and resource management by the use of Android, an application will be developed using input from the paper's discussion of the usage of cutting-edge technologies like WSN and ML for decision support in hydroponic farming.

Mobile Application for Hydroponics Farming

Government-backed projects in the Philippines are also pushing for more sustainable, tech-driven farming systems. In a 2024 initiative by the Department of Agriculture Western Visayas, a P3-million smart greenhouse was launched at Ephrathah Farms in Iloilo. The facility uses solar energy to power a hydroponics system designed for high-value crop production. While the project integrates automated watering and climate control, it is also poised for mobile app integration to enhance remote accessibility. According to the Department of Agriculture (2024), the greenhouse not only aims to boost food production but also serves as a tourist attraction and training center for other farmers. Local government officials view it as a driver of rural development, offering job opportunities and increasing local income. The success of this project illustrates how solar-powered, tech-enabled hydroponics can serve both economic and environmental goals. With proper scaling and education, similar systems can be rolled out across other provinces.

2.1.2 Foreign Literature

Overview of Greenhouses

Despite being popular with many farmers and agriculturists due to its ability to conserve resources and higher production of crops (Zala, 2024), hydroponics still has its disadvantages. One of its many disadvantages is its vulnerability to power outages (Zagelow & Zagelow, 2024).

Traditional greenhouses face several challenges, including temperature and humidity control. In the Philippines, heat is one of the challenges for gardeners because some of the plants are sensitive to heat. According to PAGASA, the average temperature of the Philippines is 26.6 degrees, but it can rise to 28.30 degrees or higher. Humidity is also one of the challenges because too much humidity can invite pests and disease, but low humidity can cause plants to dry out. According to PAGASA, the humidity level in the Philippines is high ranging from 71% to 85% due to the country being surrounded by water. That is why proper ventilation is important in maintaining the conditions of the greenhouse to prevent these problems (Porter, 2024). Additionally, greenhouses are not self-sufficient and dependent, meaning traditional greenhouses are reliant on external resources such as electricity and manual monitoring by farmers to keep them in healthy condition. 50% of the greenhouse costs come from basic energy consumption such as light, temperature control, and other instruments needed in a greenhouse. However, it is also important to mention that not all greenhouses use these instruments. They are more focused on manual ways to maintain the condition of the greenhouse. Water, as well as its management is one of the important resources and processes needed for greenhouse operations. Greenhouses can use water from different sources, such as rainwater, pond water, well water, and even tap water for irrigation. Water management of greenhouses differs and is usually influenced by their budget. Low-budget greenhouses may rely on manual labor, which can be labor-intensive. On the other hand, high-budget greenhouses may use automated irrigation systems, such as drip irrigation, which can provide a consistent and efficient water supply (Hall, 2023).

Hydroponics are reliant on electricity because they primarily use electronic instruments to provide water flow throughout the system. Therefore, using batteries is recommended but it can contribute to the greenhouse costs (Nadaraja, 2023). Hydroponics requires constant monitoring of water conditions, which are pH level, temperature, and micro and macronutrients (Hale, 2023).

The types of greenhouses are determined by using their covering material and shape. The commonly used covering materials are glass, plastics, and films (Maraveas, 2023). These materials are considered low-cost greenhouses because they are easy to erect and affordable, and they usually do not use any technology to improve the condition of the greenhouse. Glass greenhouses are more traditional than plastics ones. They are much preferred because they transmit high near-infrared (NIR) reflection and photosynthetically active radiation (PAR) and reduce IR radiation despite being much more expensive. They provide better control of temperature and light conditions, promoting healthier and more robust plant growth. Plastics, including Polycarbonate and Polyethylene films, are the best alternatives to glass. They are much cheaper, provide a decent light transmission and help maintain humidity. Polycarbonate is more durable than Polyethylene films, it can withstand strong winds and heavy rain, making it more resilient than Polyethylene films.

Greenhouses act as man-made incubation sites for plants, overcoming agricultural boundaries, including the ability to grow seasonal and temperature-sensitive plants by nurturing the greenhouse to meet the plant's requirements. These processes involve controlling temperature and ventilation and water for irrigation and protecting plants against pests and harsh climate conditions. Greenhouses have undergone numerous adaptations over millennia (Nemali, 2022) and were incorporated into new innovative processes and technologies such as hydroponics. The rise of technology has fueled a significant interest in developing sustainable hydroponic greenhouses due to the increasing demand for eco-friendly and self-sufficient gardening solutions.

Greenhouses with the use of hydroponics are already an existing method that farmers and agriculturists have been using since the Babylonians and Aztecs era Singer (2021). Hydroponics is a process of nurturing plants without the use of soil; instead, it uses nutrient solutions to deliver essential elements for plant growth. Compared to the traditional soil used in growing plants, hydroponics reduces water loss due to runoff and the need for pesticides and herbicides caused by microorganisms that are present in the soil. Hydroponics also maximizes space efficiently by vertically stacking plants, which is suitable for urban farming or gardening where space is limited.

The architectural style of greenhouses also varies based on their specific use and environmental conditions (Dalai, 2020). The Lean-to greenhouses are ideal for small spaces because they are built against existing structures. They are good for on-a-budget individual gardeners who seek inexpensive structures and maximize sunlight with minimal roof support. Their disadvantages are limited in space, light, ventilation, and temperature control.

The Even Span Greenhouse is commonly used among gardeners because of its symmetrical design, which is good for ventilation and temperature. They are likely to be small and attached to a house, which provides flexibility for more plants. Their disadvantages are likely to be expensive because of its larger space. Contradictory to the Uneven Span Greenhouse, it is versatile in locations with uneven terrains like hillsides. However, they are rarely used as they are not suitable for automation.

The Ridge and Furrow greenhouses are commonly used in Europe and Canada because of their ability to minimize labor and automation costs and manage large spaces. They specifically manage snow and rainwater through gutters and provide large interior space for better management. Their disadvantage is needing a strong structure to handle snow, which can be costly.

The Saw tooth greenhouses are good at managing ventilation naturally and light transmission and have a unique design that is comparable to a saw blade. Much the same as ridge and furrow greenhouses because it also reduces interior temperature. However, they needed extra structural plans for effective climate control.

The Quonset greenhouses are much cheaper and easy to erect because they use pipe arches and Polyethene films, which make them ideal for small operations. The structure can be free-standing or interlocked to maximize the use of space; however, they are less durable compared to the more robust structures mentioned above.

Many commercial hydroponic greenhouses use automated systems that monitor and control water conditions, reducing the manual work for farmers (Maldonado et al., 2020)

Innovative Planting Methods

Hydroponics is a new method of farming, where cultivation of plants is through a water method instead of the soil that farmers used before. This new method provides crucial features from the environment for developing plants properly.

According to Pomoni et al. (2023), in Agricultural Production, Hydroponics is a cost-effective industrial type to produce vegetable since it is a soilless-based method. Production can build up, excluding large-scale chemicals dispensing to the environment. The Hydroponic Greenhouse can provide higher-annual yield as it works in controlled environments, 95% of irrigation water are saved, and uses less land. It is also a controlled system that makes it more industrialized. Hydroponic Greenhouse can be managed by controlling the temperature, water level, and humidity, resulting in improved productivity and enhanced socio-economic development.

In the study of Austria et al. (2023), the Hydroponic Greenhouse features a Monitoring Android Application that is IoT-based, where it can manipulate and manage parameters of the environment such as humidity, light, temperature, pH, and water level. Hydroponic cultivation is the process of supplying nutrients to a plant's roots through water with nutrients. Hydroponics is a convenient greenhouse in areas with no arable land and areas with climatic conditions that also benefit urban areas with a conflict of producing food without soil.

Hydroponics does not include soil cultivation; it promotes cleanliness in planting environments, saves fertilizers and resources (land surface area), and conserves and reduces the consumption of water. Consumption of chemicals like fertilizers, improvers, and pesticides is reduced. Compared to Traditional Cultivation, Hydroponic Cultivation is faster by 30%-50%.

Hydroponics also faces difficulties as it requires high investments, technical demand, large amount of electricity consumption, and adoption of this cultivation method may hold considering it needs monitoring and constant support; thus, Farmers should be cautious (Pomoni et al., 2023).

Hydroponics

According to Shilpa, Sharma, P., and Bansuli (2024). Hydroponics is a technique for growing vegetables that uses irrigation water to give organic nutrients to the roots instead of using soil as a rooting medium. Agriculture must therefore embrace technologies that could conserve water and enhance the nutritional content or biochemical properties of vegetable food products. Compared to a conventional system, this technology uses water more efficiently. Hydroponics is the process of cultivating plants in a solution that contains both macro- and micronutrients.

According to Saldigner et al. (2023), soilless farming is a viable alternative for growing crops, healthy edible vegetables, and nutrient-dense food plants in the current environment. In 1842, German scientists Julius von Sachs and

Wilhelm Knop enumerated nine necessary components for plant growth, marking a significant turning point in the history of hydroponics. Their research on soilless cultivation aided in determining which nutrients plants require to thrive in the absence of soil. Hydroponics systems were later developed in the 20th century because of this discovery.

Sharma et al. (2023) highlights that while hydroponics presents numerous benefits, several challenges must be overcome to fully harness its potential. Key barriers include high initial investment, technical demands, and substantial energy consumption. Moreover, maintaining proper nutrient levels and managing diseases are essential to ensure successful crop growth in hydroponic systems. Despite these challenges, this method offers promising opportunities for enhancing food production, particularly in urban settings where arable land is scarce.

Hermawan et al. (2022) emphasize that one of the key benefits of hydroponic systems is their efficient use of resources, especially in terms of space and water. With the rapid integration of advanced technologies into everyday life—such as smart home systems (domotics), IoT-enabled growing methods, and AI-driven solutions, more individuals are exploring alternative cultivation techniques. The widespread accessibility of online information has also encouraged this trend. Consequently, both hydroponic and indoor farming practices are gaining popularity among modern farmers.

Researchers have explored the use of wastewater in hydroponic systems, demonstrating that hydroponics can efficiently remove various pollutants while simultaneously producing food crops. The study found that hydroponic systems could achieve significant removal rates for pollutants such as chemical oxygen demand (COD), total nitrogen, total phosphorus, copper, and zinc. However, challenges like high energy consumption and public acceptance remain, indicating the need for further research to optimize these systems.

A review addressed the environmental challenges associated with global agrifood systems and highlighted hydroponics as a sustainable, plant-based food production technique suitable for urban areas. It emphasized that integrating hydroponics into urban food production could enhance food security and environmental sustainability, though challenges like initial investment and technical expertise need to be addressed.

The Greek words "hydro," which means water, and "ponos," which means labor, are the roots of the term "hydroponics." The term was first used in 1929 by California scientist Dr. Gericke, and it signaled the transition from laboratory technique to a commercially successful plant cultivation method. During World War II, the U.S. Army used hydroponic culture to grow food for soldiers stationed on barren Pacific islands. By 1950, large-scale hydroponic farms had been set up in Asia, Africa, Europe, and America (Shrestha and Dunn, 2020).

Automated Hydroponic Greenhouses

Dennison et al. (2025) provide a thorough analysis of how automation and robotics are transforming hydroponic and aquaponic farming methods and improving their scalability, sustainability, and efficiency. The study investigates the integration of important technologies, including sophisticated lighting solutions and automated nutrient and pH management systems. These developments minimize labor dependency, maximize resource use, and greatly increase productivity. The study addresses scalability and energy constraints while looking at case studies that demonstrate increases in yield and resource efficiency. This review highlights how automation has the potential to revolutionize hydroponic systems by offering practical insights and stressing the value of energy-efficient equipment and sustainable practices.

According to studies by Silviya et al. (2024) and Dennison et al. (2025), automation, robotics, and the Internet of Things (IoT) are transforming hydroponic greenhouses and improving scalability, sustainability, and efficiency. By enabling real-time monitoring and control of crucial parameters like temperature, pH, lighting, and nutrient levels, these technologies greatly increase yield and lessen reliance on labor.

In terms of plant monitoring systems, the value of IoT sensors is providing continuous, accurate data on environmental factors like temperature, humidity, and soil moisture. These systems help minimize human error, optimize plant care, and support sustainable farming.

The integration of automation, IoT, and data analytics in agriculture, particularly in hydroponic systems, is not only improving productivity and sustainability but also making advanced farming methods more accessible to a broader range of users—from urban gardeners to commercial growers.

Hydroponic Lettuce Cultivation

This study investigated the impact of varying electrical conductivity (EC) levels on the growth of lettuce and basil in a hydroponic vertical farming setup. Five different EC levels, ranging from 0.5 to 2.0 dS m^{-1}, were tested to determine their effects on plant development. The results indicated that an EC of 0.9 dS m^{-1} was optimal for lettuce, leading to enhanced biomass production and healthier plants. Higher EC levels did not proportionally increase growth and, in some cases, negatively affected plant health, underscoring the importance of precise nutrient management in hydroponic systems.

Lettuce growth and quality can vary significantly depending on the type of growing medium used in soilless cultivation. In a comparative study by Abu-Zahra et al. (2025), different soilless media—such as cocopeat, a peat moss-perlite mix, and a soil-inclusive medium—were evaluated against a hydroponic nutrient solution setup. The researchers assessed various parameters, including head size, leaf area, moisture content, and biomass. Findings revealed that lettuce grown in hydroponic nutrient solutions exhibited superior growth, with larger heads and greater overall biomass compared to other treatments. Although cocopeat resulted in the highest leaf moisture content, the inclusion of soil was found to hinder root development, negatively impacting the plant's structure. These results reinforce the effectiveness of hydroponic systems in maximizing lettuce size and quality.

Maintaining a stable and optimal pH level in hydroponic nutrient solutions is essential for maximizing plant health and productivity. In a study by Hosseini, Fabbri, van den Vijver, and Mészáros (2023), lettuce plants were grown in nutrient solutions with varying pH ranges: 5.0–5.5, 5.5–6.0, and 6.0–6.5. The results showed that plants cultivated within the 5.5–6.0 pH range exhibited significantly better photosynthetic activity and larger leaf areas than those in other treatments. This research emphasizes the importance of precise pH control in hydroponic systems, particularly within the recommended range, to ensure optimal physiological development in lettuce.

Hydroponic and soil-based cultivation systems offer distinct advantages and limitations when it comes to growing lettuce. In a comparative study by Lei and Engeseth (2021), Giant Caesar lettuce was cultivated under both methods over a 35-day period to evaluate differences in plant morphology, texture, antioxidant capacity, and functional qualities. While both systems produced lettuce with similar above-ground size and leaf dimensions, hydroponic plants developed significantly longer roots and retained more moisture. Interestingly, soil-grown lettuce showed higher antioxidant capacity, whereas hydroponically grown leaves were softer with firmer midribs—possibly due to greater lignin content. These findings highlight that while hydroponics can match soil cultivation in growth rate and size, physiological and nutritional differences between the two methods remain significant.

Mobile Application in Agriculture

Kamal et al. (2023) investigate how mobile applications are transforming the agricultural sector by empowering smallholder farmers through better access to information and enhanced resource management. The research highlights how these apps provide real-time data on crop prices, farming techniques, and pest control strategies, allowing farmers to make well-informed decisions that boost productivity and improve crop yields. Additionally, the study discusses how mobile apps support efficient farm operations by offering tools for tracking resources like water and fertilizers, ultimately minimizing waste and increasing efficiency. This improved management of input leads to better resource allocation, resulting in higher yields and greater income for smallholder farmers. The growing use of these digital tools continues to significantly enhance their livelihoods.

Patra (2023) discusses the growing use of e-learning to enhance communication and information sharing in agriculture, particularly through e-agriculture initiatives aimed at supporting rural and agricultural development. The process involves stages such as idea generation, design, analysis, and implementation to address the challenges faced by farmers, including the lack of timely access to crucial information like soil health, weather patterns, and rainfall. The review emphasizes the need for platforms that allow farmers to share experiences, insights, and resources to ensure that agricultural knowledge is effectively utilized.

One of the major issues highlighted is the limited availability of real-time data and communication networks, which often leaves farmers uninformed about market conditions and other critical updates. The study explores how mobile applications can play a vital role in streamlining agricultural development by offering practical tools and up-to-date information. These apps help farmers learn new techniques to boost productivity and efficiency, despite limitations such as poor internet connectivity in remote areas.

Overall, the article concludes that while challenges exist, mobile apps provide significant advantages. They empower farmers to access valuable information independently, reducing reliance on intermediaries who may offer overpriced or low-quality inputs. Thus, mobile applications are becoming essential tools for enhancing agricultural productivity and sustainability in developing nations.

Huang et al. (2020) explain that the rapid advancement of mobile technologies and wireless internet services has significantly contributed to the expansion of the mobile app market. To support this continued growth, ensuring the usability of mobile applications is essential. Given the distinct features of mobile devices—such as limited screen size, varying connectivity, processing power, and different usage contexts—apps must be designed with a high degree of usability. While usability needs may differ depending on the type of app, a general lack of understanding about mobile app usability can result in poorly designed applications, ultimately affecting user acceptance. The study offers a comprehensive review of mobile app usability, examining the connections between usability principles, design features, and attributes. It aims to guide better usability design practices by highlighting common usability elements across mobile apps as well as features specific to app categories.

Most people, including farmers and rural residents, use mobile devices these days. Since agriculture is the backbone of the Indian economy, mobile-enabled information services and the rapid expansion of mobile telephony have improved information sharing in the knowledge-intensive agriculture sector (Mane et al. 2020). Mobile applications provide varied information services to farmers that are helpful for management, controlling, and monitoring of the farm. Mobile applications are a great way for farmers to expand their operations and make more money. This study examines the ways in which mobile applications for agricultural services have affected farmers' farming operations and the more cutting-edge services that will be offered via mobile apps.

Web Application for Hydroponic Monitoring System

According to Buraczyńska et al. (2024), Web applications are used to solve technical problems and introduce innovations. They allow better use of the capabilities of the created systems and support the process of their management. Creating a web application to manage a system for monitoring the conditions of growing potted plants will allow it to be used by people who do not have gardening knowledge and users who do not have high technical skills (including computer skills at an advanced level).

According to Wahyuni, S., & Khusnia, R. H. (2020). Madura Island is one of the largest peanut producers in Indonesia, but the production of peanuts produced on average is still relatively low, ranging from 0.7 to 1.5 tons/ha. The low yield of peanuts is caused by several factors, one of which is unstable environmental conditions and pests that attack plants. Efforts to increase production can be made by monitoring plants. A monitoring system and control of peanut growth in a web-based plant house were designed. This system will carry out monitoring in the form of real-time video and the detection of temperature and humidity sensors to stabilize the conditions in the plant house based on conditions of temperature and soil moisture. The monitoring system provides 2 control modes, automatic and manual control to handle watering solenoids and heating lights. The results of designing a monitoring and control system obtained data that is real-time video capable of monitoring with speeds of 110 kb/s to 420 kb/s, sending sensor monitoring data no later than 1 second from the detected temperature changes, and manual controls running according to the command on/off and not affected by environmental conditions day and night. Automatic controls run in accordance with the conditions set based on readings on sensors of temperature and soil moisture. Ambient temperature affects the level of soil moisture and the operation of the web can be accessed from different laptops but only on 1 network, and the web can only be accessed by someone who has an ID.

2.2 Related Studies

2.2.1 Local Studies/System

What is a Greenhouse: A Review

According to Austria et al. (2023), Hydroponics is an integrated Internet of Things (IoT) for a Smart Greenhouse, therefore, it does not require much space and land, uses less water, and does not require pesticides. Controlling, maintaining, and monitoring greenhouse and plant parameters (Humidity, Light intensity, pH level, and Temperature) are automated, allowing for remote monitoring and reducing manual labor. It alerts users to changes in critical parameters.

However, it also faces challenges as the setup cost is expensive. Technical Complexity can occur at any time, thus requiring programming knowledge, calibration of sensor issues, and a need for expertise for wiring and system design are crucial. Hydroponics relies on electricity to power some of the hardware (cooling system, pumps, and sensors) and for real-time monitoring of parameters. Sensors are limited due to the limitations of the Microcontroller. The system requires maintenance and debugging for updates and enhancements. Consistent data validation required longer testing. (Austria et al. 2023)

Climate change and more people make farming land less. This is a big problem in the Philippines, where farming is key. Greenhouse farming and hydroponics can help. They allow growing crops all year, even in bad weather. Hydroponics uses nutrient-rich water, not soil, to grow veggies like lettuce, kale, and basil. IoT tech, like smart sensors and wireless communication, helps control pH, light, and temperature in greenhouses. Apps made with MIT App Inventor make plant care easy and automated. IoT solutions improve function, reliability, and use, as shown by ISO 9126 tested systems. This helps modern, sustainable farming (Austria et al., 2023).

Hydroponics: A Deeper Discussion

In a study conducted by Fernandez and Dela Cruz (2023), in Cebu City, hydroponics was explored as a sustainable farming method. The research highlights several advantages of hydroponics, such as water efficiency, faster plant growth, and the ability to grow in areas with poor soil quality. However, the study also noted some disadvantages, including high initial costs for equipment and the need for technical expertise to manage the system effectively.

According to Garcia et al. (2022). This local study traces the development of hydroponics technology in the Philippines, starting from the early adoption of soil-less farming techniques in the 1990s. The authors discuss the first experimental projects, the introduction of commercial hydroponic systems, and government programs aimed at promoting hydroponics as a sustainable agricultural practice. They also highlight key milestones such as the establishment of training centers and the integration of hydroponics into urban farming solutions.

Hydroponics grows crops with just minimal input. It saves resources and makes nutrient-rich plants. A study made an IoT system to control water temperature, which is important for plant growth (19°C to 27°C). They used cooling modules, Wi-Fi, sensors, and a pump. This system keeps the water temperature steady. Tests showed it cooled water to 26°C in 30 minutes, which is good for hot areas like Malaysia. This tech is a big step for sustainable farming. (Development of an IoT-based water temperature control and monitoring system for hydroponics 2022).

The Automated Hydroponic Greenhouse: Operation and Efficacy Analysis

Hydroponics, a soilless growing technique, depends on accurate nutrient management to maximize plant growth, according to a study by Sulaiman et al.

(2025). With emphasis on the possibilities of hydrogen (pH) and electrical conductivity (EC) dosing frameworks, it offers a methodical scoping evaluation of automated hydroponic nutrient dosing systems. To improve dosage speed, accuracy, and robustness, it emphasizes the necessity for strong frameworks that incorporate sophisticated dosing frameworks and simultaneous dosing procedures. Using multiple regression models to integrate predictive data, a novel framework is suggested to fill these gaps. The objective of this framework is to enhance automated hydroponic fertilizer dosing systems' resilience, accuracy, and dosing speed. The results highlight how crucial it is to do more study on adaptable frameworks to satisfy the rising need for precise hydroponic systems.

Agriculture has seen significant transformation because of the use of IoT technologies, which have made it possible to develop plant monitoring systems (Prithviraj et al., 2024). The most important factors influencing plant health, including as soil moisture content, temperature, humidity, and light levels, are measured in real time by these kinds of systems using a variety of Internet of Things-based sensors and devices. IoT solutions that combine cloud computing and data analytics are useful for offering actual insights into farming operations, which maximizes resource consumption and raises crop productivity.

An Android-based plant monitoring application aimed at supporting vegetable growers. The system utilizes sensors to track soil moisture, temperature, and humidity, helping farmers determine the appropriate time for watering their crops. Based on evaluations from three different groups of users, the system received a "very good" rating, indicating effective performance. However, for enhanced reliability and long-term use, the system needs to be made more robust by incorporating more durable and cost-effective materials. The study also confirmed that the system is safe for users, with no incidents of injury reported during operation. Santiago (2020) noted that such a plant monitoring system holds promise in helping farmers maintain crop health and productivity, ultimately contributing to an improved quality of life through automated monitoring and irrigation support.

Optimizing Lettuce Growth: EC/PPM, pH, Size, and Growth Rates in Hydroponics vs. Soil

The search for sustainable alternatives to commercial hydroponic nutrient solutions has led to the exploration of natural additives like seaweed extract. Montecillo et al. (2024), conducted a study on red leaf lettuce, examining the impact of replacing portions of the standard nutrient solution with seaweed extract. Their research found that substituting up to 25% of the solution did not significantly affect plant growth, including parameters such as leaf number, leaf area, and overall biomass. This suggests that seaweed extract can be a cost-effective and environmentally friendly supplement to conventional hydroponic nutrients.

The choice of culture pot can also influence the physical characteristics of hydroponically grown lettuce. Pattung and Pattugalan (2023) explored how different container types—specifically styrofoam fruit crates, plastic basins, and net pots—affected plant height, leaf count, and coloration. Their findings indicated that lettuce grown in styrofoam crates achieved the tallest growth, the highest number of leaves, and a vibrant green appearance, making it the most visually and commercially desirable. Moreover, their cost analysis showed that using affordable, repurposed materials like styrofoam crates significantly reduced production expenses without compromising quality, making them a practical option for local, small-scale growers.

The practicality of hydroponics in urban agriculture has been gaining attention in local research. Buenconsejo (2021) conducted a study comparing the growth of lettuce (Lactuca sativa) in hydroponic and traditional soil systems during the 2020–2021 academic year. By measuring parameters such as plant height and leaf development, the study found that lettuce grown hydroponically demonstrated a noticeably faster growth rate and greater biomass accumulation. These results support the potential of hydroponic systems as a more space-efficient and productive alternative in urban environments where soil limitations are common.

Mobile Application for Hydroponics Farming

Innovations in vertical hydroponic farming in the Philippines are beginning to incorporate multiple layers of automation and smart monitoring. Alajas (2023) designed a smart hydroponic vertical farm that allowed for the simultaneous cultivation of lettuce, basil, and arugula through a polyculture method. This system used computational intelligence to control growth variables and included a web-based interface for remote oversight. Although the system was web-based, its infrastructure could be easily adapted for mobile app control. The study included vision-based plant monitoring and used real-time feedback to adjust pH and electrical conductivity, ensuring optimal growing conditions. Moreover, the system was designed with scalability in mind, making it practical for both household use and small-scale commercial farming. A techno-economic analysis showed its potential for profitability, which strengthens the case for future public or private investment. This work proves that smart farming in the Philippines can move beyond experimental setups to real, impactful applications.

Austria et al. (2023) developed an Internet of Things (IoT)-enabled smart greenhouse system tailored for hydroponic gardens, addressing challenges such as climate change, diminishing arable land, and food security concerns. The system integrates sensors to monitor critical parameters like pH, temperature, humidity, and light intensity, with data visualized through the ThingSpeak platform. A mobile application facilitates remote monitoring, enhancing user convenience. The system underwent evaluation using ISO 9126 criteria, receiving a "Very Good" rating with a mean average of 4.06, indicating high reliability and usability. Test results showcased optimal conditions: pH level at 7.77, light intensity at 83, water temperature at 27.94°C, greenhouse temperature at 27°C, and humidity at 75%. The study recommends incorporating solar energy to power the system, aiming to enhance sustainability. This integration of IoT and renewable energy presents a viable solution for modern agricultural challenges.

A significant advancement in hydroponic farming is the development of an automated smart system that incorporates mobile application control for nutrient management and monitoring in NFT-based systems. In this study, Guzman (2023) explains how the system uses a mobile app to manage and monitor critical parameters such as pH, nutrient concentrations, and water levels. The system integrates sensors connected to a mobile interface, which sends real-time data updates to the user. This allows farmers to make timely adjustments to their crops' environment, improving both efficiency and crop yield. The mobile application is crucial in this setup because it provides a user-friendly interface that enables remote monitoring and control, giving users the flexibility to manage their hydroponic system from their smartphones. This integration allows for real-time data collection and analysis via the cloud, making it an efficient tool for precision agriculture. As highlighted in Guzman's (2023) findings, this mobile-based system is particularly beneficial for small-scale farmers as it reduces the need for constant manual intervention and optimizes resource usage. The mobile app, therefore, plays a central role in the system's automation and management, reducing labor while improving the quality of the crops produced.

Technological innovations in agriculture, like IoT-based hydroponic greenhouses, are already being adopted by commercial farms in the Philippines. At Ephrathah Farms in Iloilo, a smart hydroponics system was deployed to automate lettuce production using solar energy and IoT sensors. According to Domingo (2022), the setup significantly increased lettuce weight from 60 grams to as much as 250 grams per head by precisely regulating temperature, nutrient solution flow, and other variables. The system's data could be accessed via an Android mobile app, giving farmers real-time control even when off-site. Technology also reduced the need for manual labor and minimized water consumption, aligning with the goals of sustainable farming. Funded by the Department of Science and Technology's Science for Change Program, the project demonstrated that such systems are both feasible and beneficial for rural enterprises. Farm managers emphasized how the system improved productivity, quality, and scheduling. This case serves as strong evidence that combining mobile applications and solar power can drive the future of farming in the country.

2.2.2 Foreign Studies/System

What is a Greenhouse: A Review

Hydroponics is one of the technologies driving in Controlled Environment Agriculture (CEA) and a leading role in urban areas with limited arable land in improving food production (Khatri et al. 2024). Hydroponics is a soilless method of cultivating plants using mineral nutrient solutions, which delivers essential nutrients to plants through water enriched. This method offers precise control over delivering nutrients, reduces water usage, and reduces the risk of soil-borne diseases. It allows for year-round crop production and faster growth compared to traditional soil-based methods. Hydroponics is compatible with sustainable agricultural practices and contributes to resource conservation (Santosh and Shukla, 2024). Common Methods of Hydroponic are the Nutrient Film Technique (NFT), deep water culture (DWC), and drip systems. All methods ensure the optimal growth of plants by controlling the precise nutrient concentrations.

From the study of Austria et al. (2023), the Hydroponics Greenhouse features a Monitoring Android Application that is IoT-based, where it can manipulate and control the pH level, humidity, light, water, and greenhouse temperature. Hydroponic cultivation is the process of supplying nutrients to a plant’s roots through water with nutrients. Hydroponics is a convenient greenhouse in areas with no arable land and areas with climatic conditions that also benefit urban areas with a conflict of producing food without soil. temperature, and water level wirelessly, resulting in improved productivity and enhanced socio-economic development.

According to Pomoni et al. (2023), Hydroponics is an emerging technology of cultivation in agricultural production. It is also a highly efficient industrial type for vegetable production since it is a soilless-based method, it is possible to increase production even without the large-scale disposal of chemicals into the environment. The nutrient solution commonly used in hydroponics contains soluble inorganic salts. This type of greenhouse can provide a higher annual yield as it works in a controlled environment, saves up to 95% of irrigation water, and uses less land. In addition, it is also a controlled system that makes it more industrialized. Sensors are connected, allowing for the control of humidity, temperature, and water level wirelessly, resulting in improved productivity and enhanced socio-economic development.

Hydroponics does not include soil cultivation; it promotes cleanliness in planting environments, saves fertilizers and resources (land surface area), and conserves and reduces the consumption of water. The use of chemicals such as fertilizers, pesticides, and improvers is reduced. Plant growth cultivation is 30-50% faster compared to traditional cultivation. Hydroponics also faces difficulties as it requires high investments, technical requirements, and a higher amount of energy consumption; continuous assistance and monitoring may prevent the adoption of this method; thus, Farmers should be cautious (Pomoni et al. 2023).

A greenhouse is a structure that serves as a controlled environment for the cultivation of crops. It serves as a solution to agricultural problems such as water irrigation, optimum structure, soil conservation, energy efficiency, climate control (temperature, humidity, ventilation), and extermination of pests (Aznar-

Sánchez et al, 2020). The concept of a greenhouse is a controlled environment for year-round crop production to address global food demands; it needs optimized growing conditions that are independent of the external climate. In order to successfully grow a favorable crop, carbon dioxide, moisture, lightning, and temperature are required to be maintained in the greenhouse (Iddio et al., 2020)

Hydroponics: A Deeper Discussion

According to Shrestha, A., & Dunn, B. (2024). This meta-analysis investigates the effectiveness of hydroponic systems in addressing global food insecurity. It highlights the significant growth of hydroponic farming, emphasizing its ability in producing continuous crops in a short period of time, requires less storage, and achieve better productivity without the climate issues or soil conditions. The study underscores hydroponics' role in providing fresh, quality food in regions with challenging agricultural conditions.

The primary benefit of hydroponic systems, according to Lokendra et al. (2024), is their effective use of resources, especially water and space. Innovative technology has becoming more prevalent in our daily lives. These technologies include AI-based systems, IoT-automated growth methods, and smart house technology (also called domotics). Remarkably, indoor hydroponic productions have found useful uses for these technologies (Kumar Selvaperumal et al., 2020; Javaid et al., 2022). For a variety of reasons, an increasing number of people are starting to investigate various growth tactics due to the wealth of information available online. As a result, farmers are increasingly using indoor and hydroponic agricultural techniques.

According to Torres et al. (2020). Vegetables and flowers have been successfully grown using the hydroponics agricultural production technique. Compared to conventional agriculture, it is more productive but requires more energy because it employs a fertilizer solution and largely regulated ambient conditions. Because plants may absorb nutrients, harmful metals, and new contaminants, hydroponic systems can be used to remediate partially treated wastewater or recovered water (RW) before it is released into the environment. The purpose of this review is to examine the benefits of hydroponics and assess the effectiveness of RW as a nutrient solution. Although there are numerous successful experiment instances, there are still few full-scale ones. Interest in hydroponics has grown because of the recent interest in vertical farming and the legalization of cannabis cultivation and using RW as a nutrient solution may now be a financially feasible option.

The Automated Hydroponic Greenhouse: Operation and Efficacy Analysis

The study of Verma (2025), discussed about the increasing need for efficient plant care in urban and indoor settings, has highlighted the limitations of manual monitoring, which can be inconsistent and time-consuming. The plant monitoring system continuously monitors the essential environmental factors:

soil moisture, temperature, and humidity in employing IoT-enabled sensors. This study addresses the problem of ineffective plant care due to human error and environmental variability, proposing an automated approach that adjusts watering schedules based on real-time data. Plant Monitoring System enhances the precision and efficiency of plant care, supporting sustainable practices and responding to the demands of modern, technology-driven lifestyles. It offers a more reliable and consistent alternative to traditional plant care methods, making it useful for individual plant enthusiasts and commercial growers.

Prathap et al. (2024) describe hydroponics as a method of growing plants without the use of soil, utilizing a nutrient-rich water solution instead. As a form of hydroculture, it relies on mineral fertilizers dissolved in water to support plant growth. One of the main challenges in this soilless system is the consistent management of nutrient solutions, which requires specific technical expertise. However, advancements in automation are playing a significant role in supporting the expansion and efficiency of hydroponic farming.

Silviya et al. (2024) conducted a study on the use of computer-controlled systems in plant cultivation, focusing on the automation of temperature, lighting, and nutrient supply. The research emphasizes the combination of hydroponics and the Internet of Things (IoT) to develop a smart greenhouse with an integrated nutrient monitoring system. A major advantage of using IoT in hydroponic setups is the real-time collection and analysis of data. These systems can be accessed and controlled via smartphones or computers, enabling farmers to receive instant alerts regarding any potential problems. This allows for quick responses, ultimately enhancing the consistency and productivity of crop growth.

Smart Greenhouse Mobile Application

According to Meirieta et al. (2024), smart greenhouses allow users to manage and monitor the planting environment remotely through mobile applications. Despite this capability, many existing apps are limited in features and have unattractive user interfaces, which can hinder their overall usefulness. To address these shortcomings, the study focused on designing a prototype mobile app for smart greenhouses by incorporating key user interface (UI) and user experience (UX) design principles. The research utilized the System Usability Scale (SUS) to assess the app's performance and followed a design thinking process—consisting of empathy, problem definition, idea generation, prototyping, and testing—to ensure the design met user needs. The prototype was created using Figma and tested by ten potential users, achieving a high usability score of 82.75, which is considered excellent. This outcome reflects the effectiveness of a thoughtful UI/UX approach in producing a functional and user-friendly smart greenhouse application.

Web Application for Hydroponic Monitoring System

According to Buraczyńska, et al. (2024), web applications are used to solve technical problems and introduce innovations. They allow better use of the capabilities of the created systems and support the process of their management. Creating a web application to manage a system for monitoring the conditions of growing potted plants will allow it to be used by people who do not have gardening knowledge and users who do not have high technical skills (including computer skills at an advanced level).

According to Hermawan, H., Uddin, N., & Darajat, T. M. (2022), a web application for a hydroponic monitoring system (HMS) is presented. The HMS is to collect data on hydroponic plants, such as quality and quantity of nutrient solutions. The HMS is integrated into the internet such that the collected data is stored in a cloud server. The data can be accessed by users through a web application. This study is to develop the web application as an interface for accessing HMS data in real time. Web development is done by implementing the user-centered design (UCD) method. A case study of monitoring hydroponic temperatures is presented in this development. It resulted in a web application that presents real-time data of the temperatures numerically as well as graphically. This web application provides an informative, attractive, and user-friendly interface of the HMS.

2.3 Synthesis of Reviewed Literature, Studies, and Systems

To make hydroponic farming more efficient, sustainable, and productive, technology is essential. Studies show that using IoT for monitoring, automating processes, and integrating renewable energy improves growing environments and lowers labor expenses.

Real time monitoring of parameters, such as the temperature , humidity , pH, and nutrient levels is made possible by IoT technologies such as Arduino and ESP32 microcontrollers and various IoT platforms. By enabling farmers to make precise modifications, these automated devices guarantee the best possible plant development. Additionally, urban growers can now access hydroponic farming remotely thanks to smartphone applications. However, the technological sophistication necessitates specialized technical expertise for setup and maintenance.

One important tactic for increasing the sustainability of hydroponic farming is the incorporation of solar electricity. Solar-powered greenhouse systems cut operating expenses and lessen dependence on traditional energy sources. Research has also investigated hybrid solar and Internet of Things systems, guaranteeing steady functioning even in the event of power shortages. Despite these advancements, high initial investment costs and potential data security concerns remain significant challenges.

In addition to automation, managing nutrients and substrates is essential to increasing crop output. In keeping with sustainable farming methods, studies have explored the usage of organic nutrient solutions and alternative growing substrates. In the meantime, hydroponics is proposed as a viable wastewater sustainability solution, illustrating its environmental advantages beyond food production. Nevertheless, there are limitations in the variety of crops suitable for hydroponics.

The advantages of automated hydroponics in raising agricultural yields, cutting labor costs, and maximizing resource use are supported by local research. In line with current trends in sustainable and technologically advanced agriculture, these findings lend credence to the creation of intelligent, solar-powered hydroponic greenhouses outfitted with Internet of Things monitoring and mobile app control. Continuous system maintenance is also crucial for smooth operation.

Overall, the development of Android applications for hydroponic greenhouses, such as these has greatly improved the efficiency and effectiveness in the urban cities. With the continued development and implementation of these systems, urban farming is likely to become even more efficient and effective in the future, addressing global food demands and promoting sustainable agricultural practices, particularly in areas with limited land.

CHAPTER 3

METHODOLOGIES

3.1 Requirement Analysis

3.1.1 Research Design

The Capstone project was entitled “AGREEMO: Development of an Android Application for Solar-Powered Hydroponic Greenhouse with Plant Monitoring and Automatic Nutrient Controller.” wants to modernize the processes of farmers on Sunnyville Community Model Farm’s of Brgy. Pasong Tamo hydroponic greenhouse, which can help reduce manual tasks and human errors. To achieve this, a prototype of a hydroponic greenhouse that can monitor and automates the water conditions and temperature and humidity levels of the hydroponic greenhouse is created alongside an Android application to streamline the data and information to the farmers. Through quantitative methods of data collection, evaluation, and interpretation, the researchers conducted a Likert scale survey of the farmers and farmer managers to derive insights into their satisfaction using our project.

3.1.2 Data Gathering Technique

The Likert Scale was used to determine the attitude of the respondent (Lindner & Lindner, 2024). The researchers specifically decided to use this technique to capture specific nuances towards the project. The scale used is a 5-point, five being “Strongly Satisfied”, four being “Satisfied”, three being “Neutral”, two being “Dissatisfied”, and lastly, one being “Strongly Dissatisfied”. There are two surveys for each type of respondent, these are the farmers and farmer managers, and agriculturists. The data gathered from all the surveys was interpreted using Descriptive Statistics to get the weighted mean.

Formula of Weighted Mean and Likert Scale Verbal Interpretation

$$W = \frac{\Sigma_{i=1}^{n} w_i X_i}{\Sigma_{i=1}^{n} w_i}$$

Figure 3.1 Mean

Where:

W = weighted average

n = number of terms to be averaged

w_i= weights applied to x values

X_i= data values to be averaged

Using Descriptive Statistics, the researchers will used the calculated Weighted Mean for each question to measure the Likert Scale Interval and get the Interpretation. The diagram and formula were inspired by Bukhari (2021)

The formula Interval = (Highest Score - Lowest Score) / Number of Score.

Table 3.1.2 Data Gathering Technique

Score	Likert Scale Interval	Interpretation
1	1 - 1.80	Strongly Dissatisfied
2	1.81 - 2.60	Dissatisfied
3	2.61 - 3.40	Neutral
4	3.41 - 4.20	Satisfied
5	4.21 - 5.00	Strongly Satisfied

3.1.3 Population and Sample Size

This study was conducted at Sunnyville Farm. This place is where the respondents are said to answer the interview that the researchers prepared. The population in this research was taken from all farmers in Sunnyville farm. The said farm has 35 farmers.

The participants in research are farmers and agriculturists, and was picked using a convenience sampling method, which gained 20 participants. Convenience sampling, a non-probability sampling technique, selects participants from the target population based on their ease of access. (Golzar et al.,2022).

Table 3.1.3 Population and Sample size

Respondents from Sunnyville Farm	**Total Population**	**Sampling Technique**	**Sample Size**
Farmers And Farmers Manager	30	Convenience	10
Agriculturists	10	Convenience	10

The table 3.1.3 presents data where the proponents employed convenience sampling for both farmer and farmers Manager and Agriculturists. The participants included ten (10) farmers and farmers manager and ten (10) Agriculturists who used AGREEMO. Convenience sampling was chosen due to its accessibility and the availability of participants. To assess AGREEMO's effectiveness, the proponents used a tailored survey questionnaire to collect descriptive data.

3.2 Requirement Documentation

3.2.1 Design of Software, Systems, Products and Processes

System Flowchart

Web

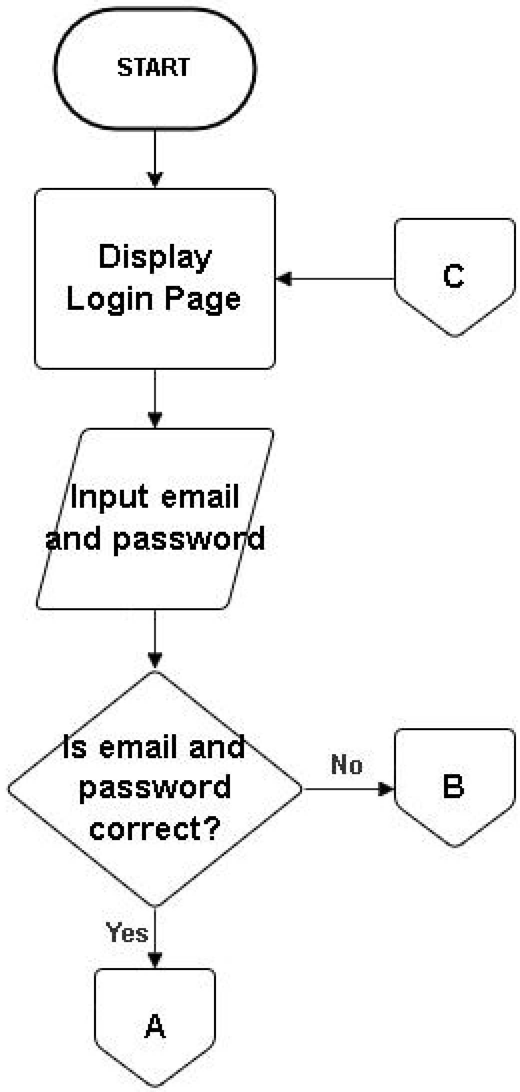

Figure 3.2.1.1. System Flowchart - Login Page

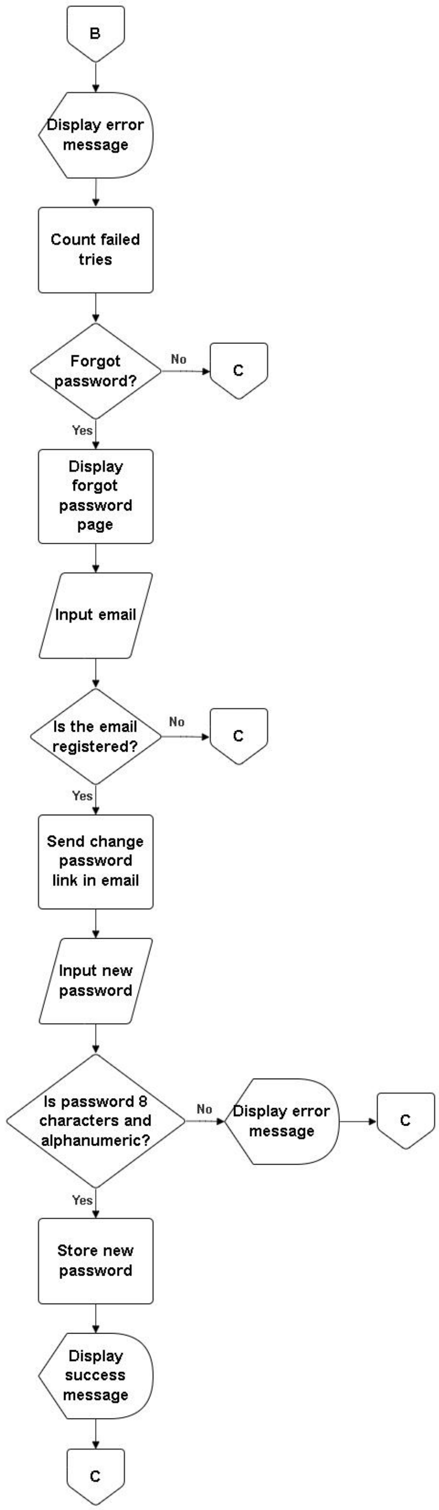

Figure 3.2.1.2. System Flowchart - Login

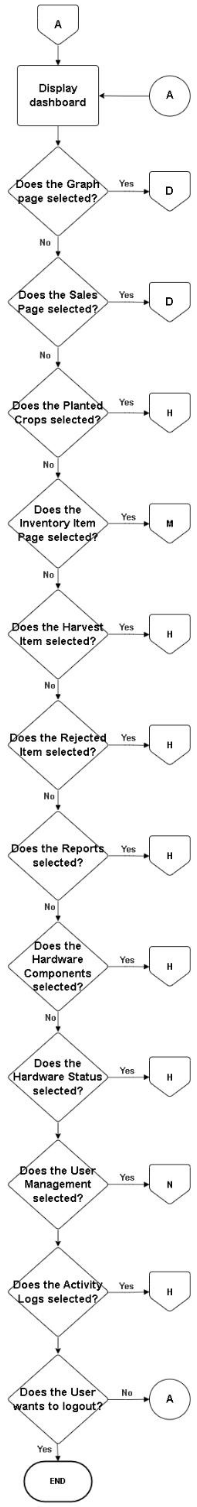

Figure 3.2.1.3. System Flowchart - Dashboard

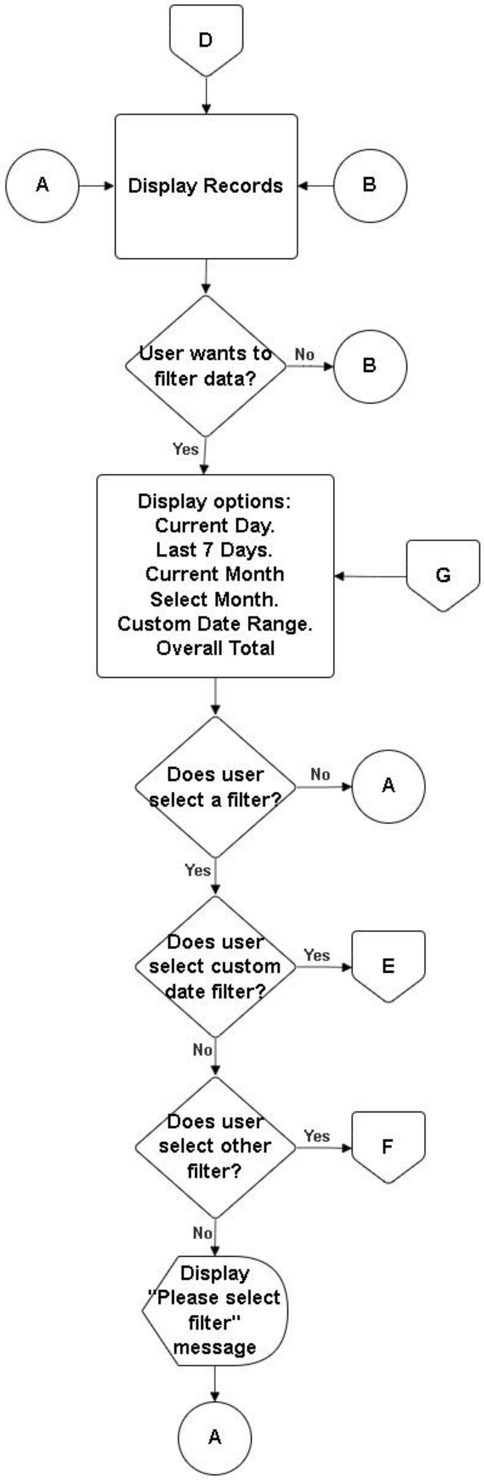

Figure 3.2.1.4. System Flowchart - Records

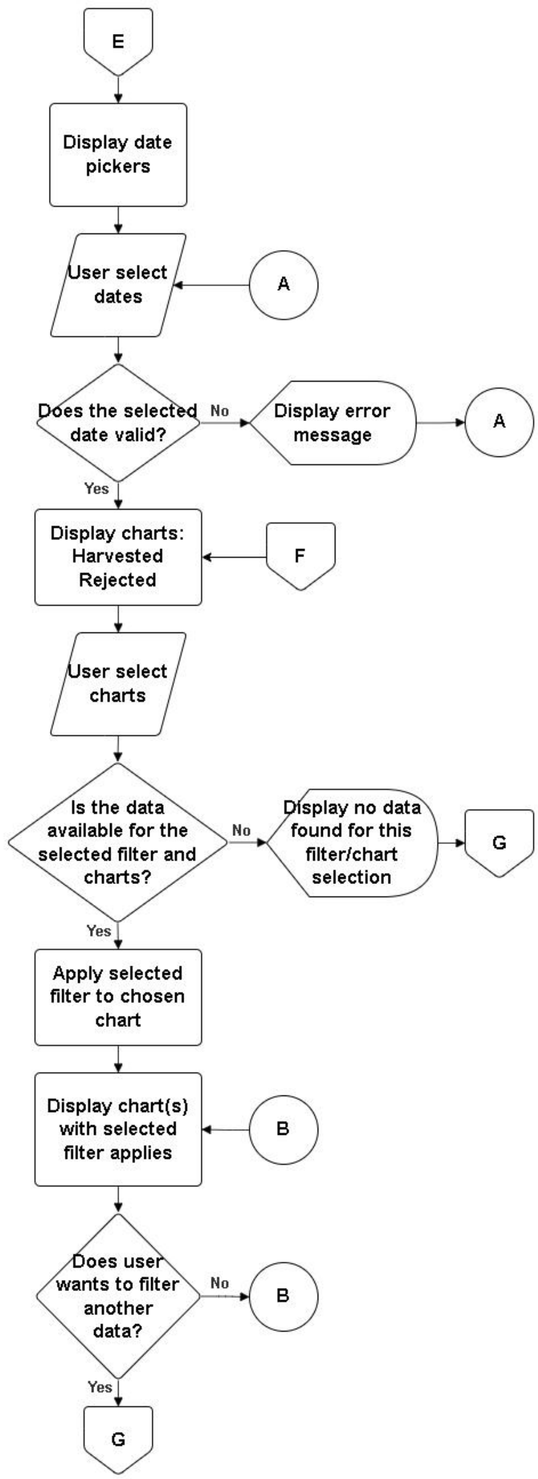

Figure 3.2.1.5. System Flowchart - Date Picker

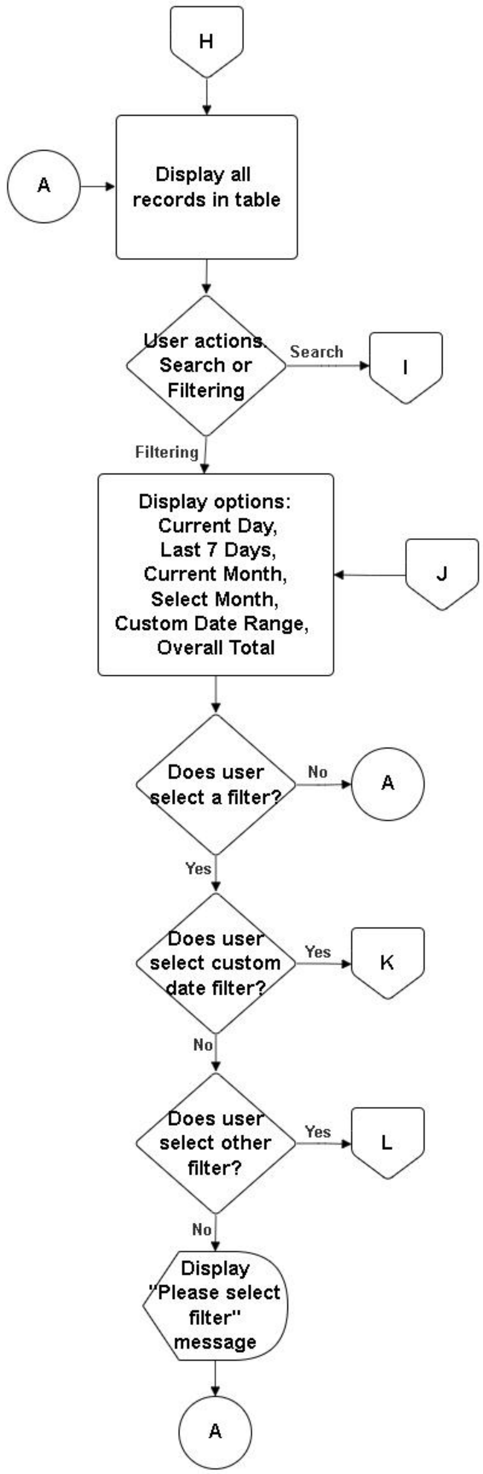

Figure 3.2.1.6. System Flowchart - Records in Table

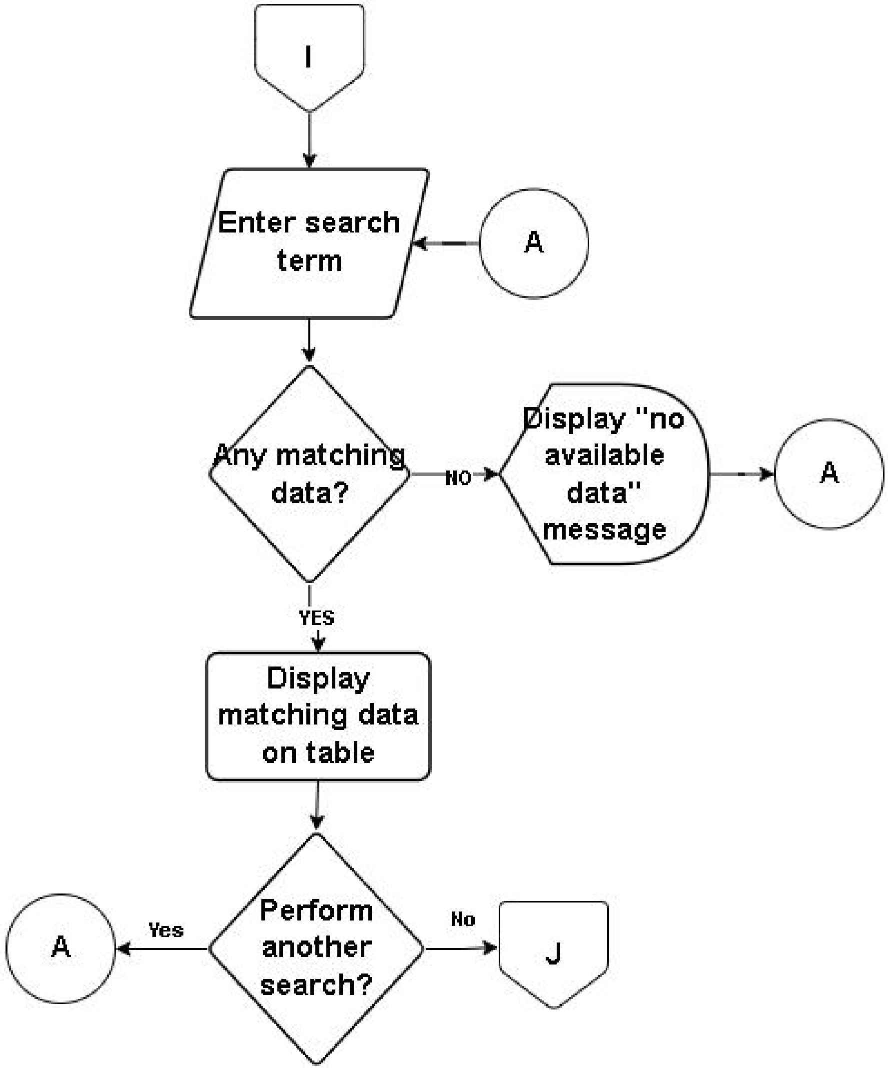

Figure 3.2.1.7. System Flowchart - Search

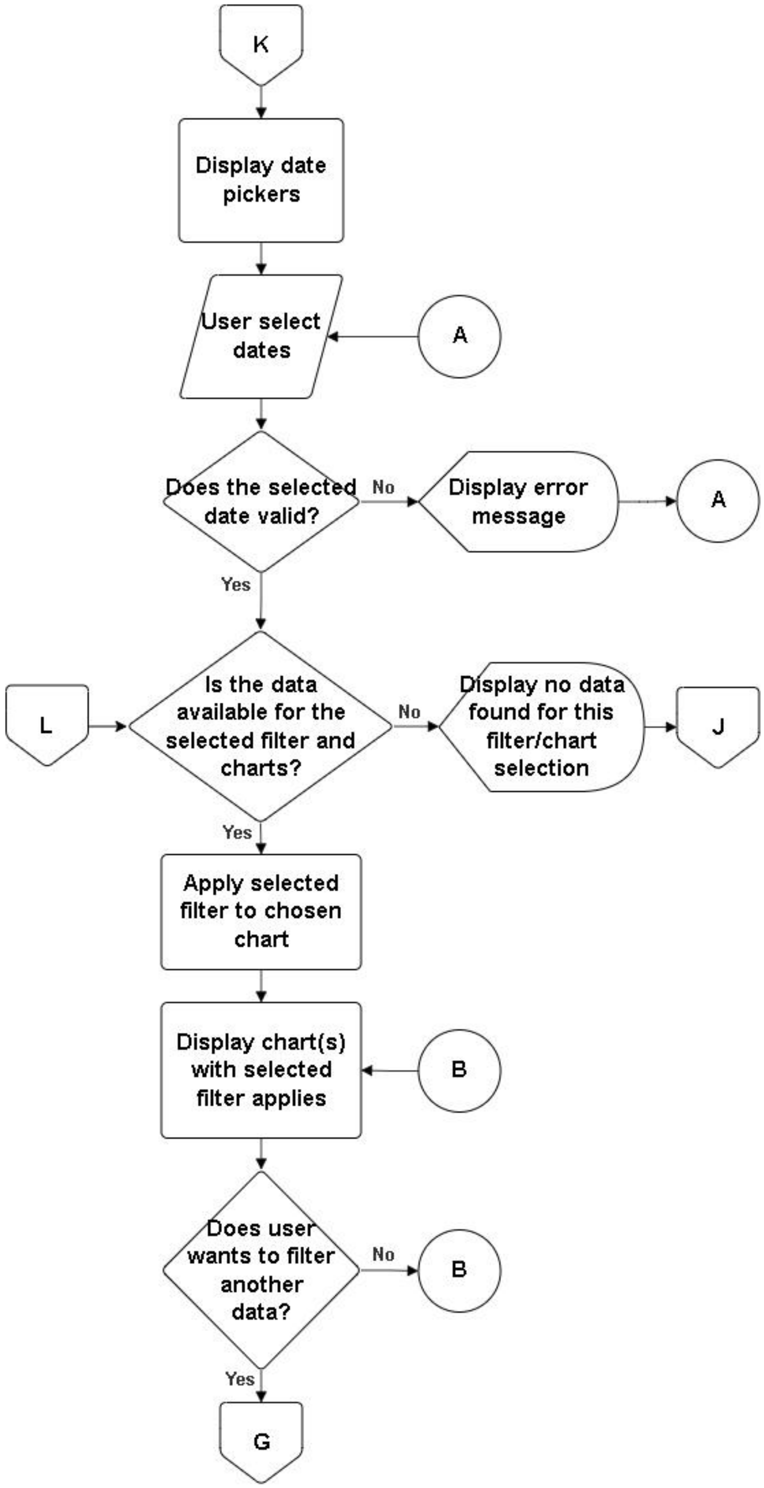

Figure 3.2.1.8. System Flowchart - Date Picker 2

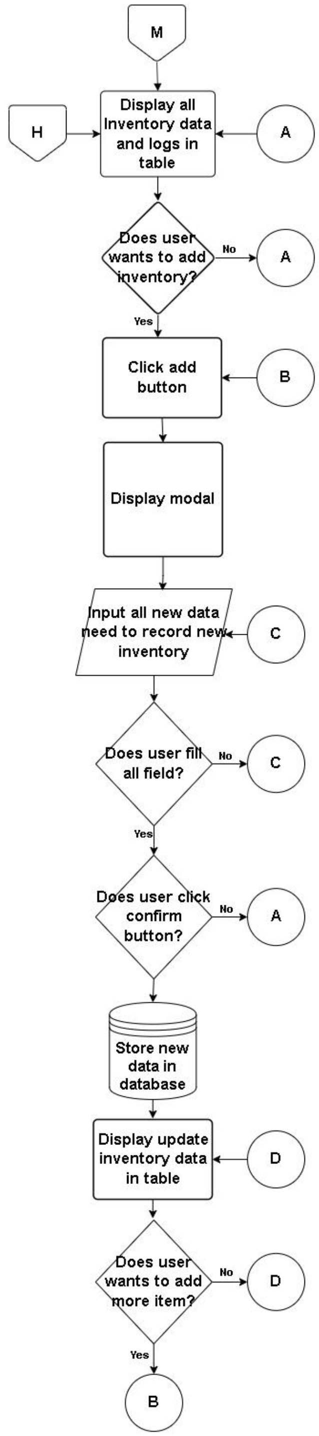

Figure 3.2.1.9. System Flowchart-Web: Inventory Data and Logs on Table

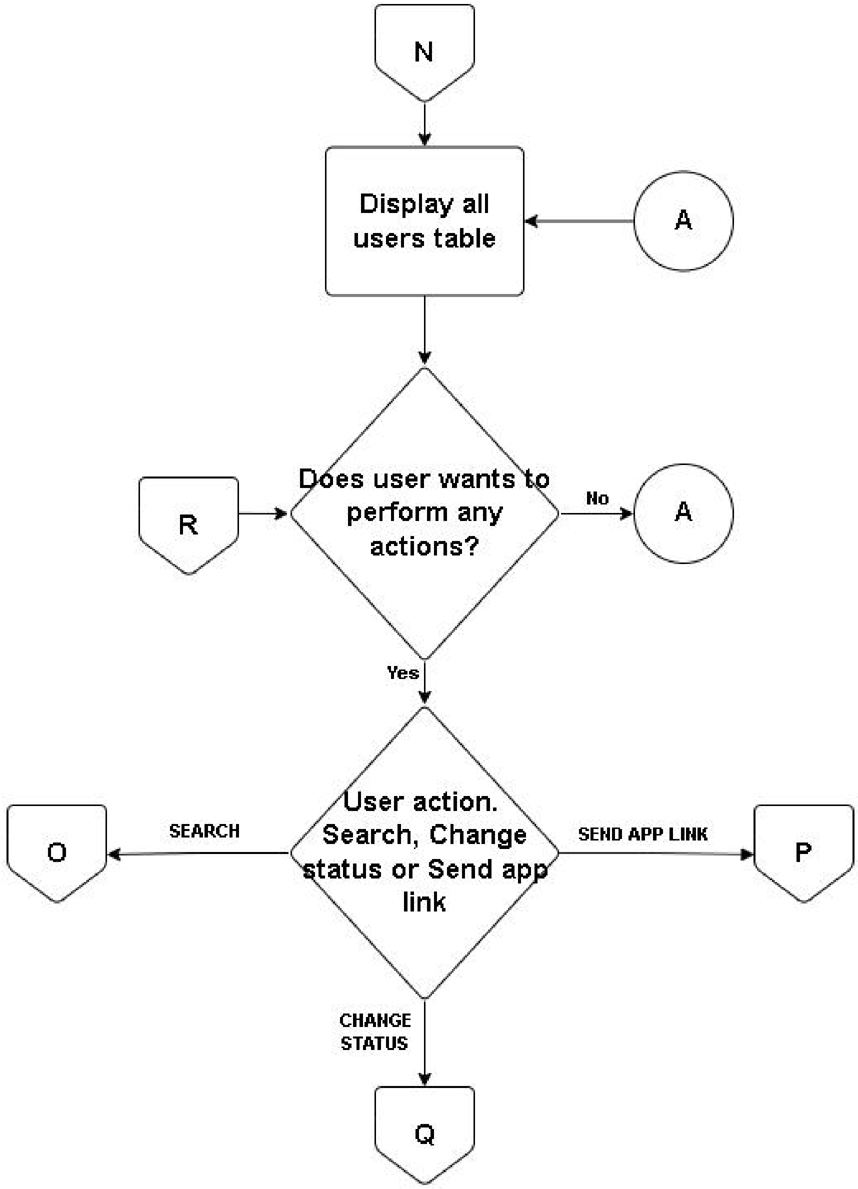

Figure 3.2.1.10. System Flowchart-Web: All Users Table

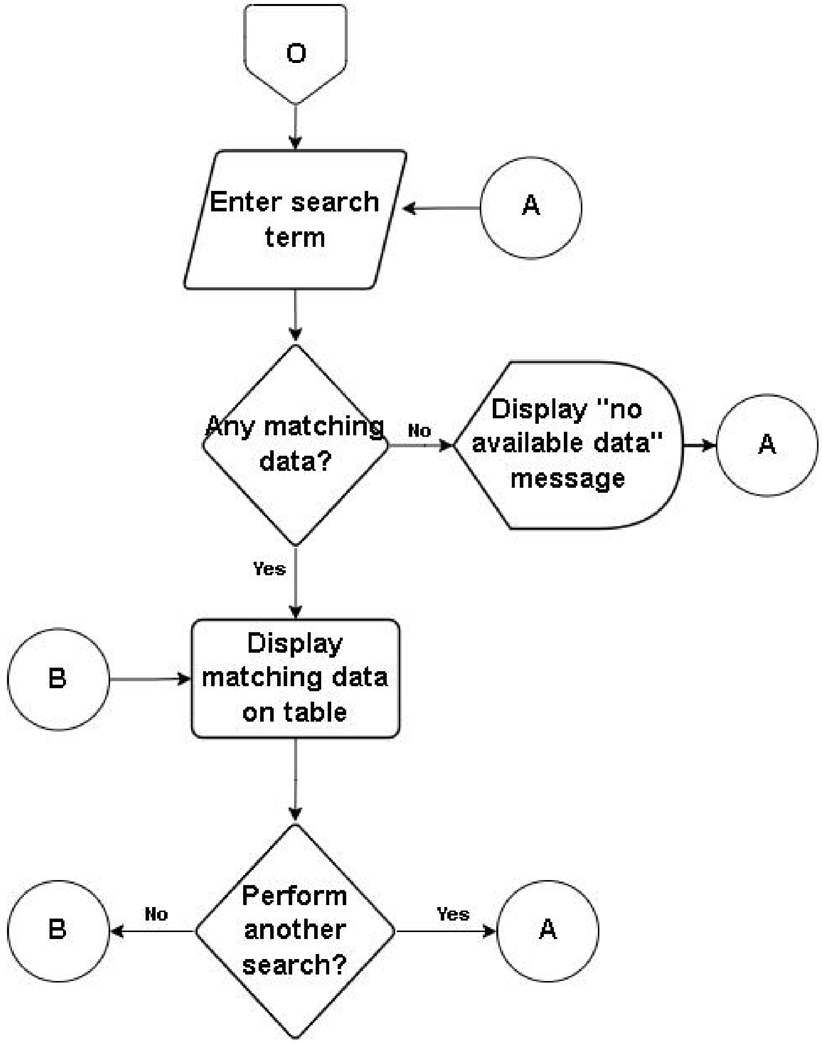

Figure 3.2.1.11. System Flowchart-Web: Search Term

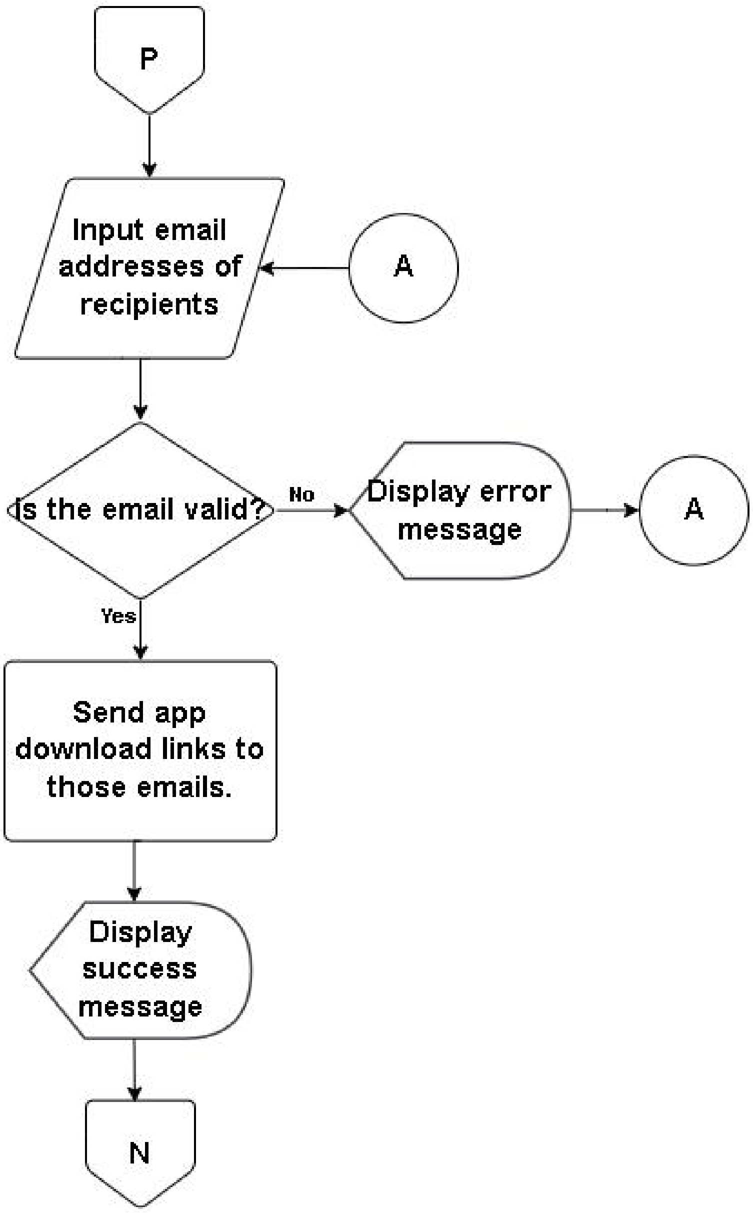

Figure 3.2.1.12. System Flowchart-Web: Email Address of Recipients

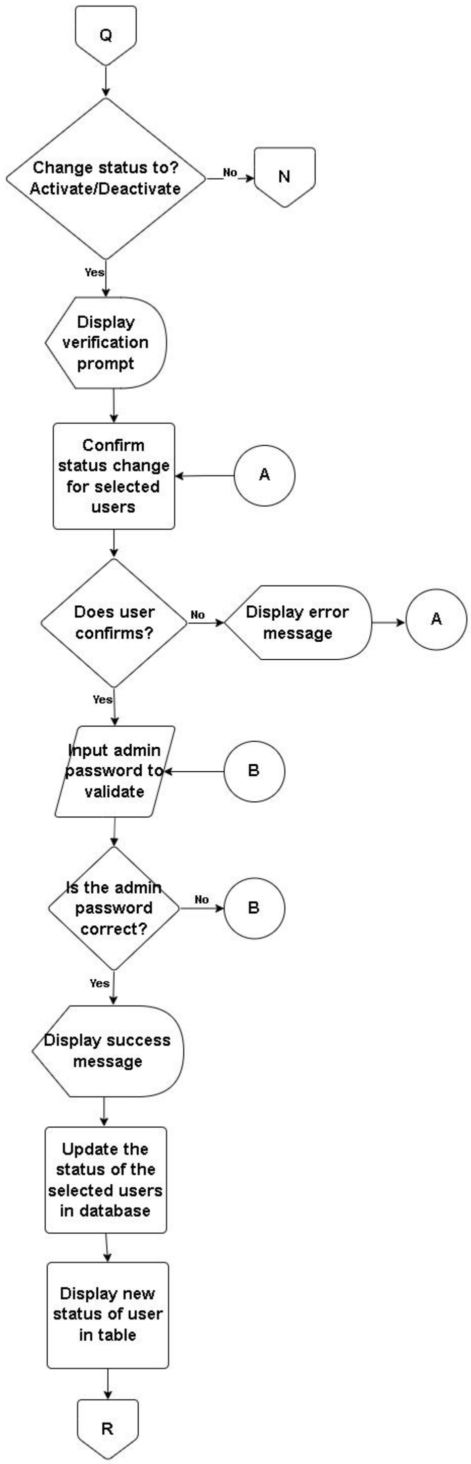

Figure 3.2.1.13. System Flowchart-Web: Change Status

System Flowchart

Mobile

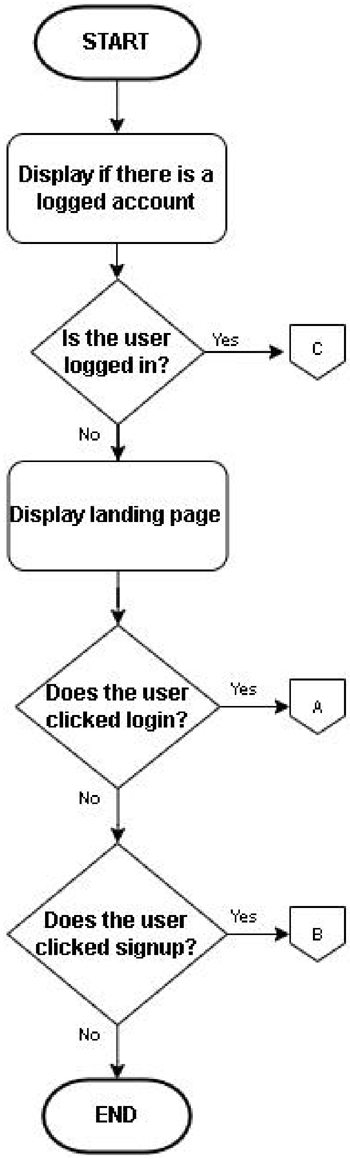

Figure 3.2.1.14. System Flowchart-Mobile: Landing Page

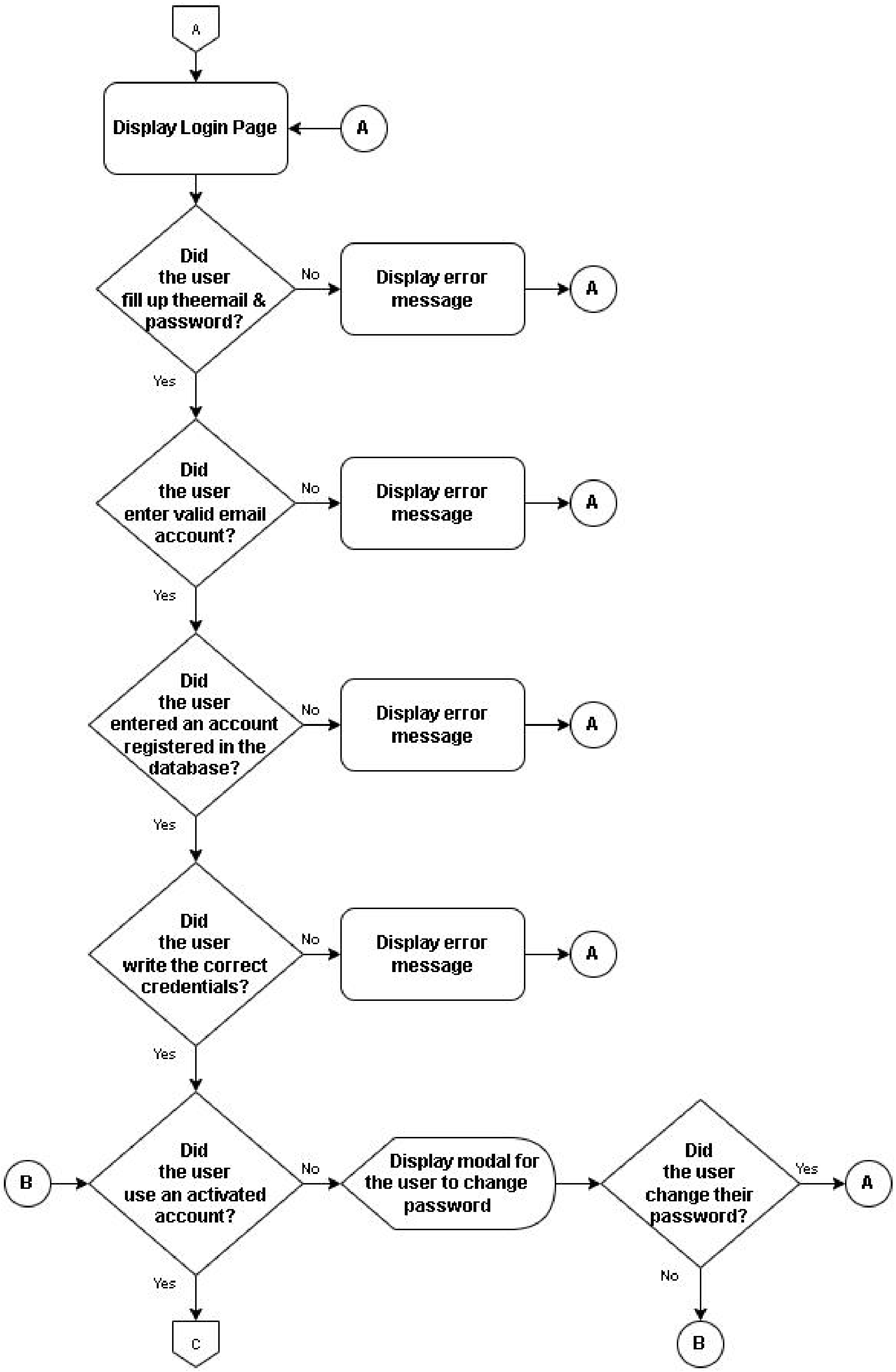

Figure 3.2.1.15. System Flowchart-Mobile: Log In Page

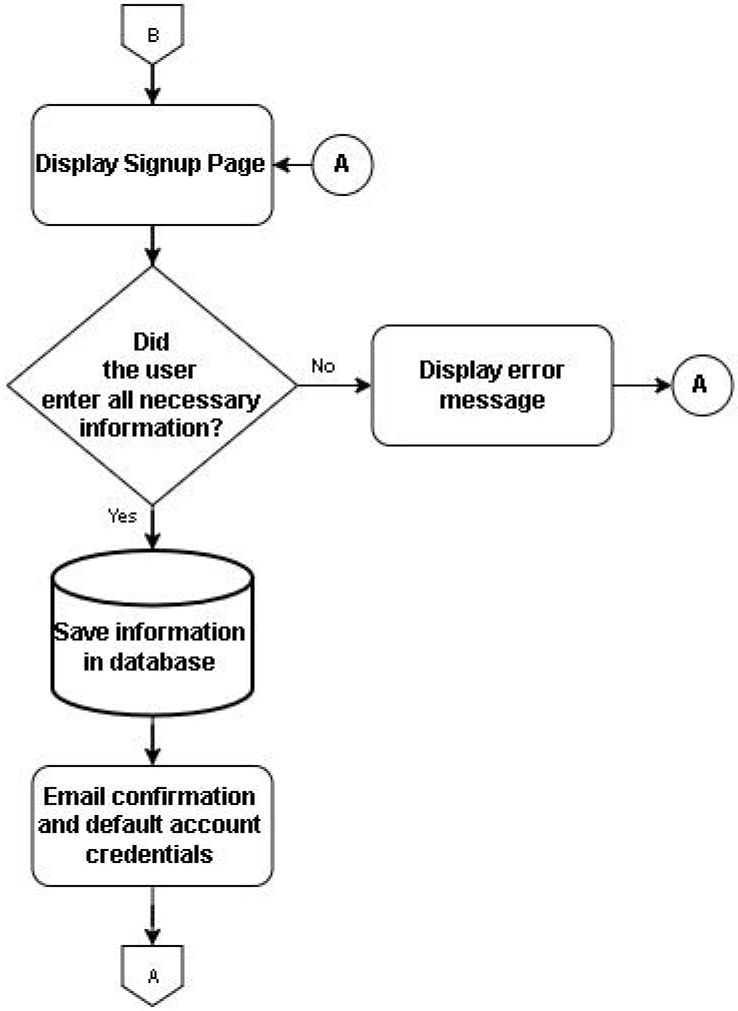

Figure 3.2.1.16. System Flowchart-Mobile: Sign Up Page

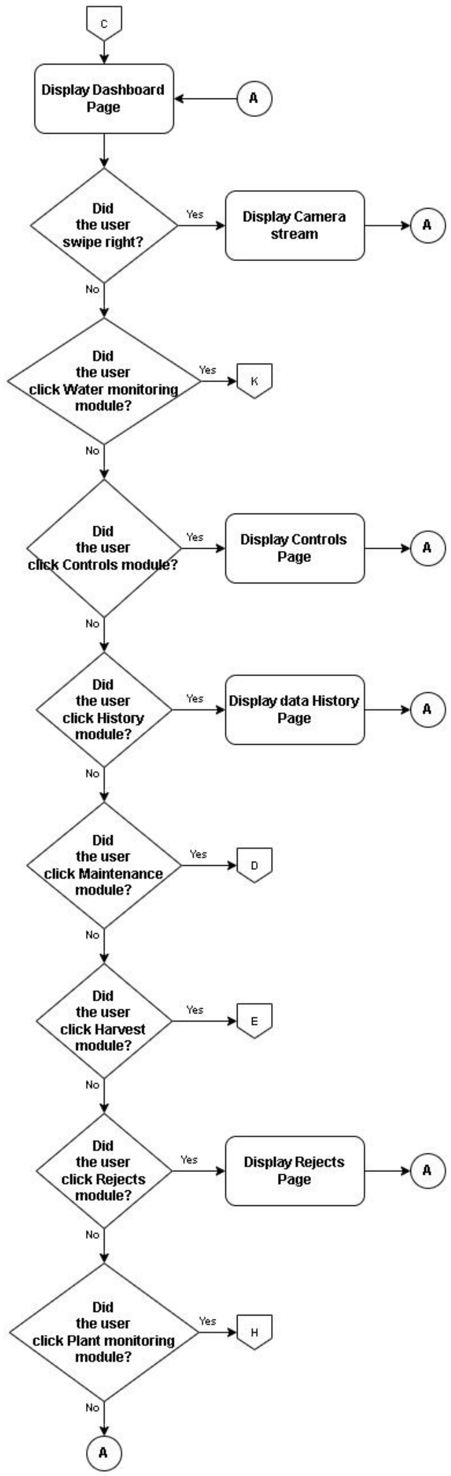

Figure 3.2.1.17. System Flowchart-Mobile: Dashboard

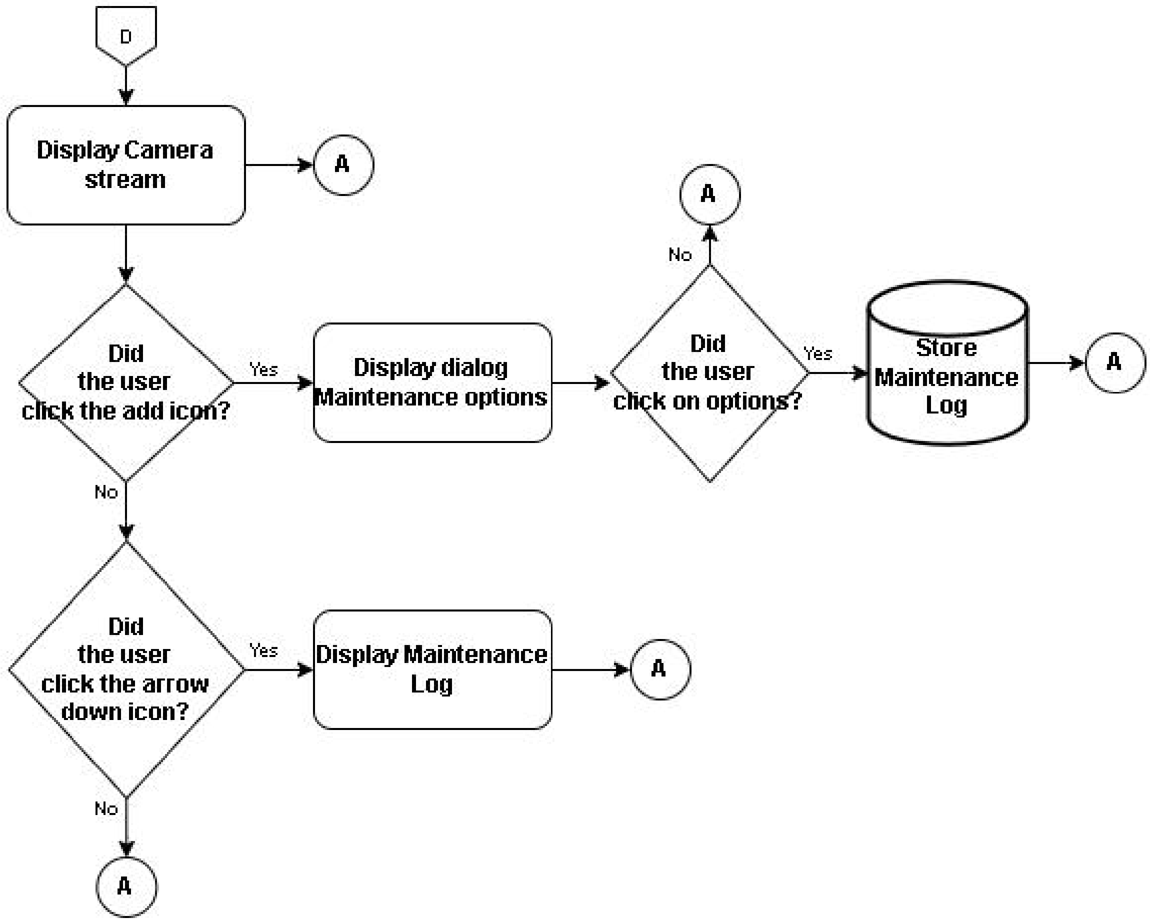

Figure 3.2.1.18. System Flowchart-Mobile: Camera Stream

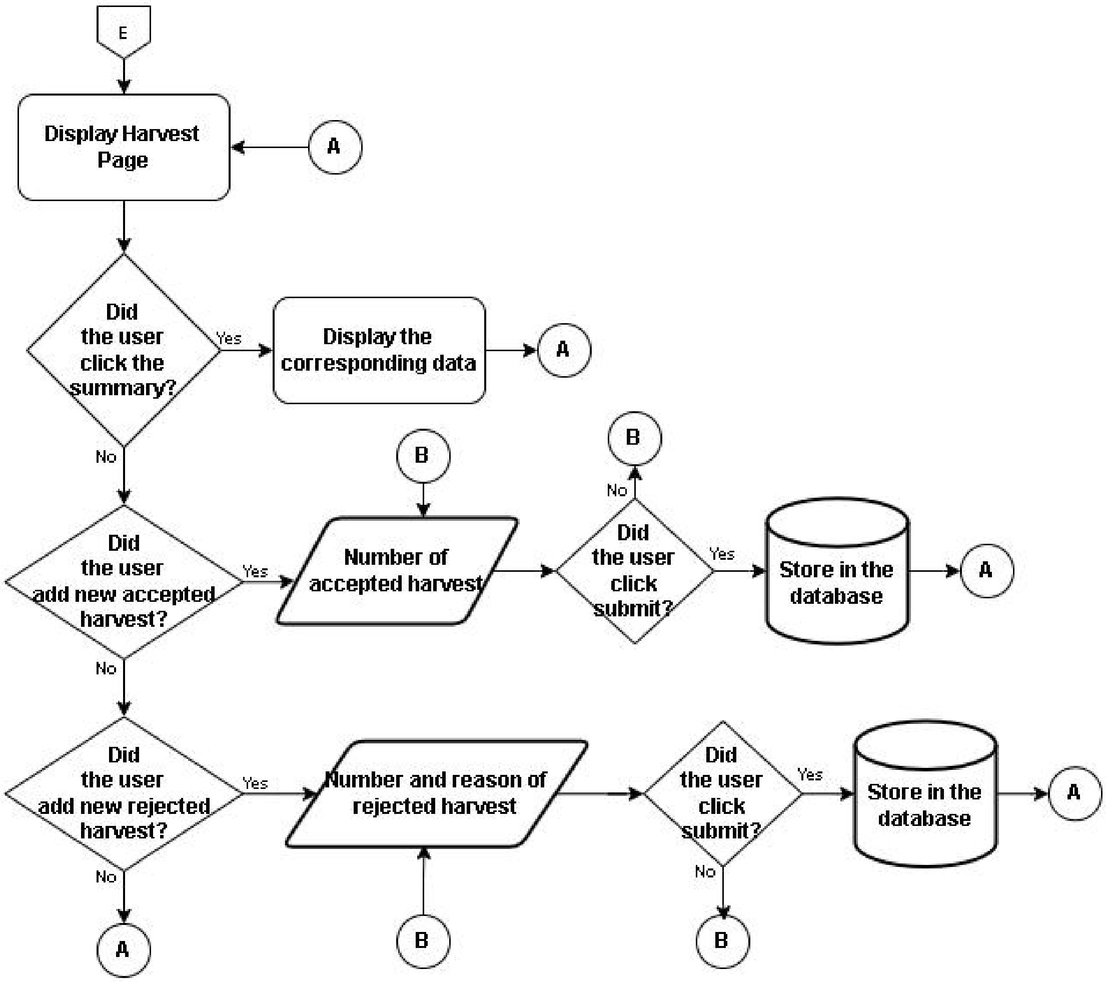

Figure 3.2.1.19. System Flowchart-Mobile: Harvest Page

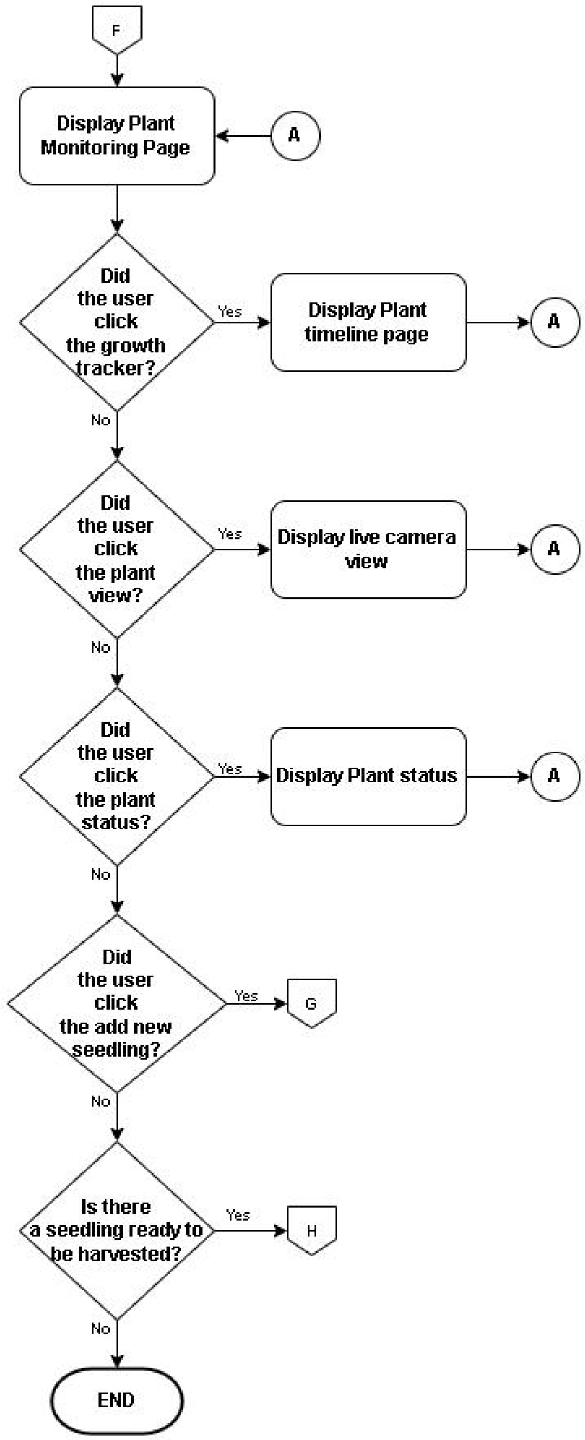

Figure 3.2.1.20. System Flowchart-Mobile: Monitoring Page

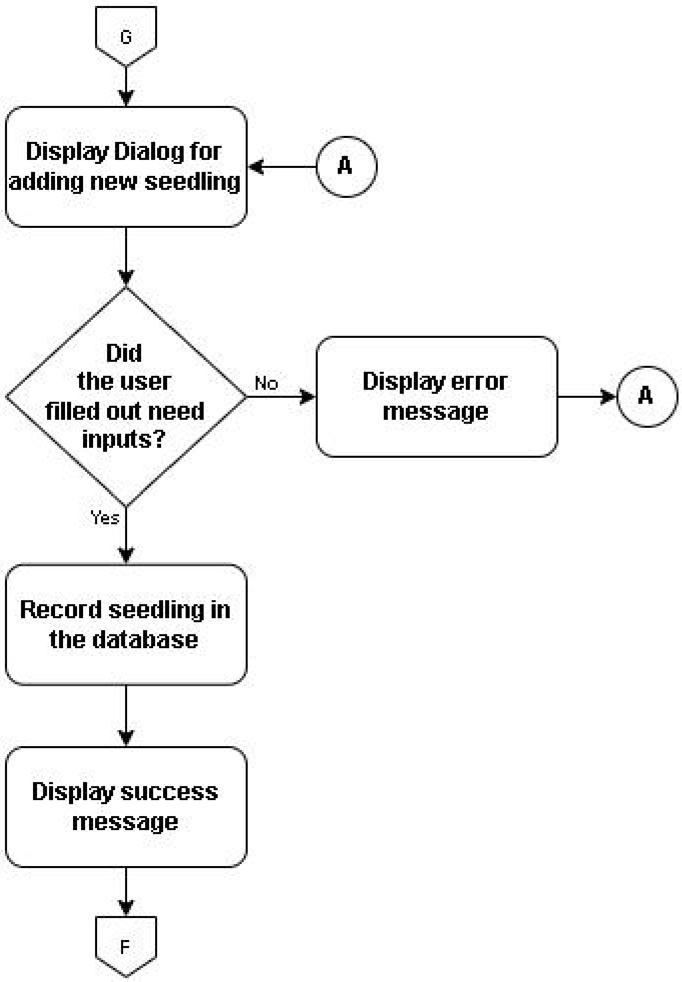

Figure 3.2.1.21. System Flowchart-Mobile: Dialog for adding new seedling

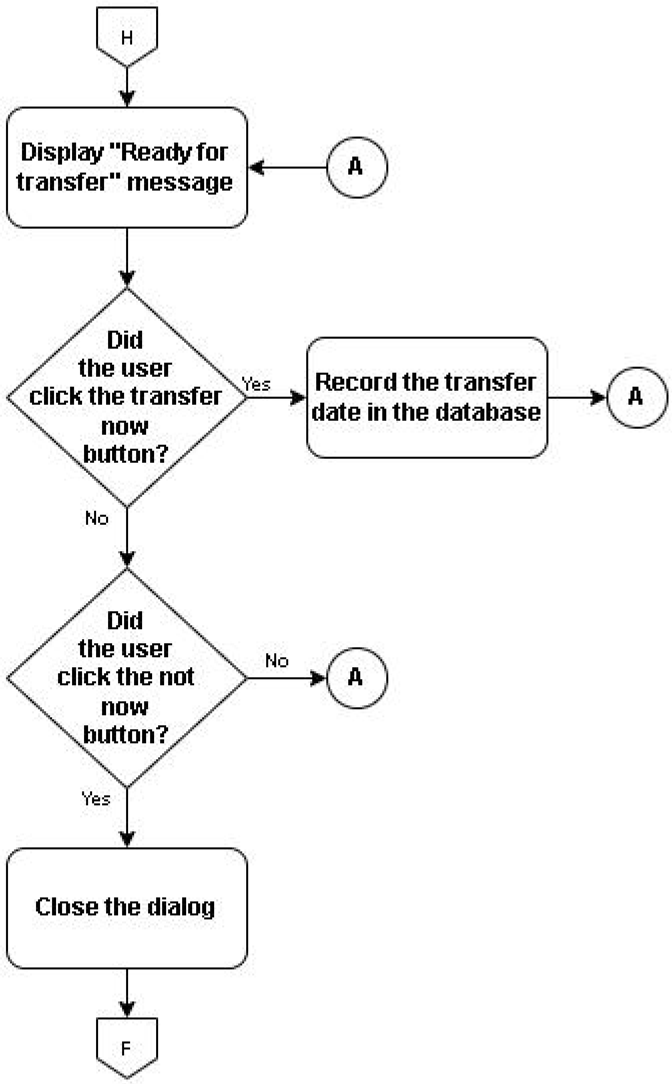

Figure 3.2.1.22. System Flowchart-Mobile: Message Display

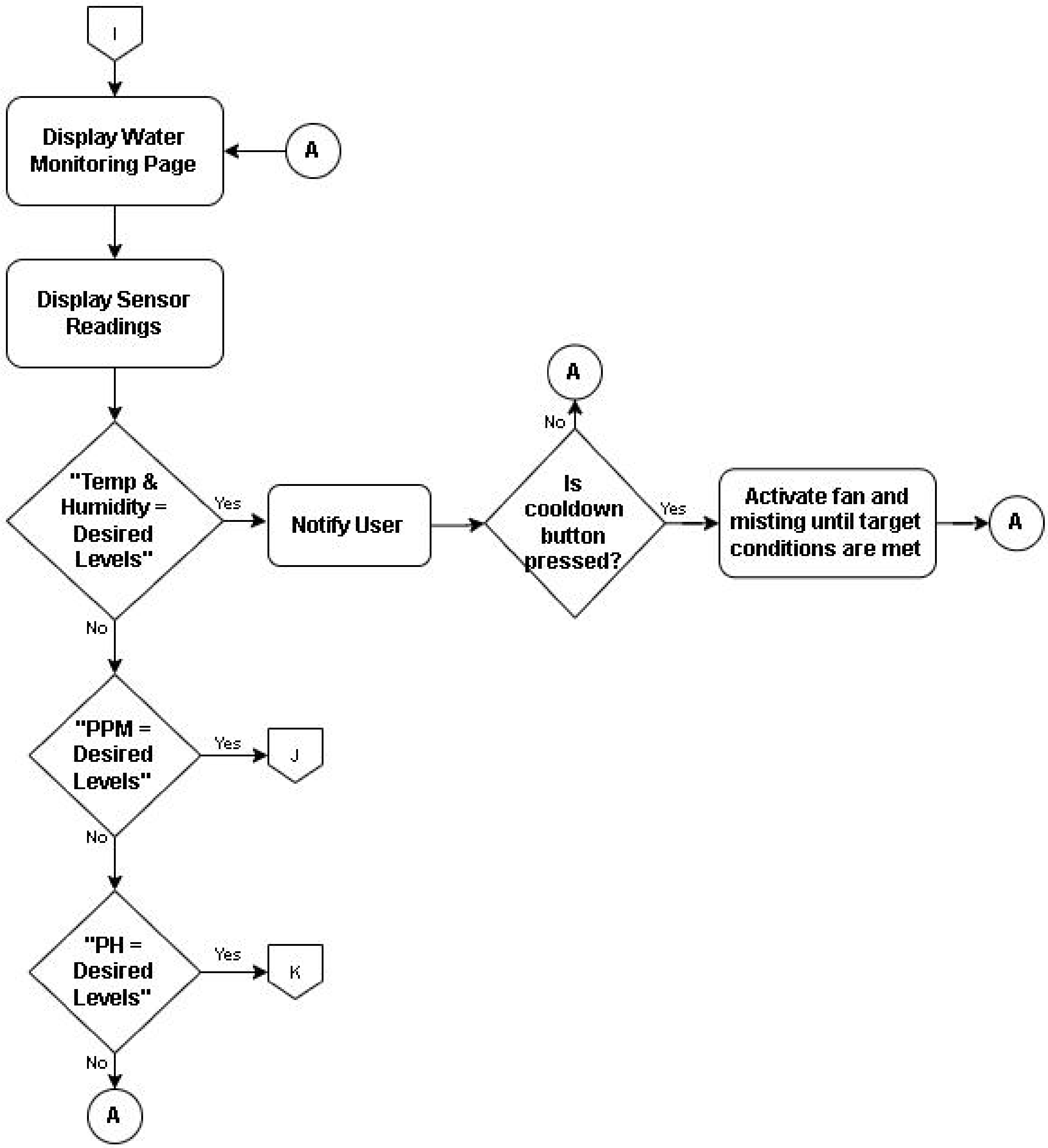

Figure 3.2.1.23. System Flowchart-Mobile: Water Monitoring Page

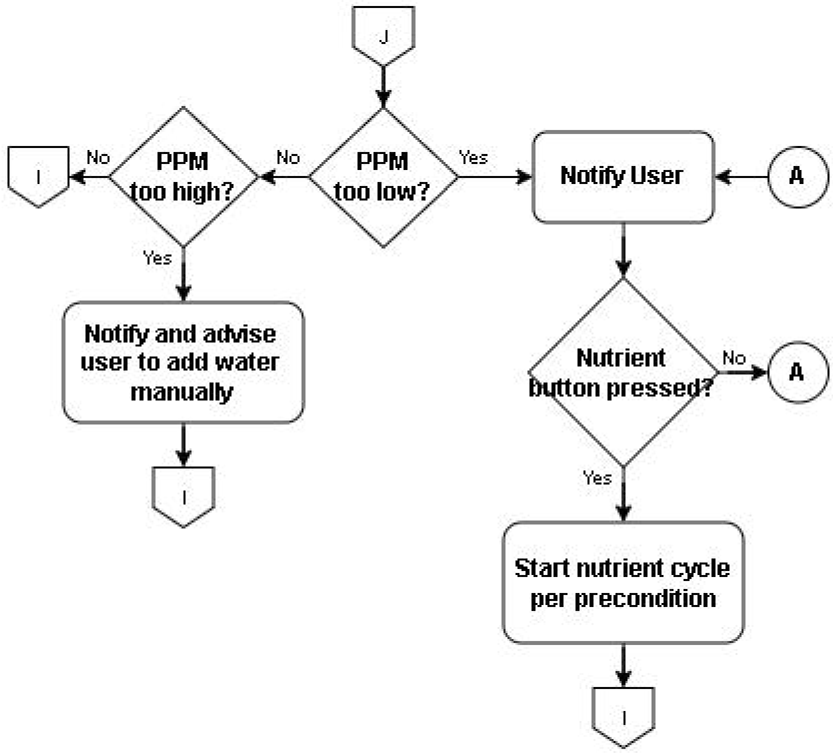

Figure 3.2.1.24. System Flowchart-Mobile: PPM Desired Levels

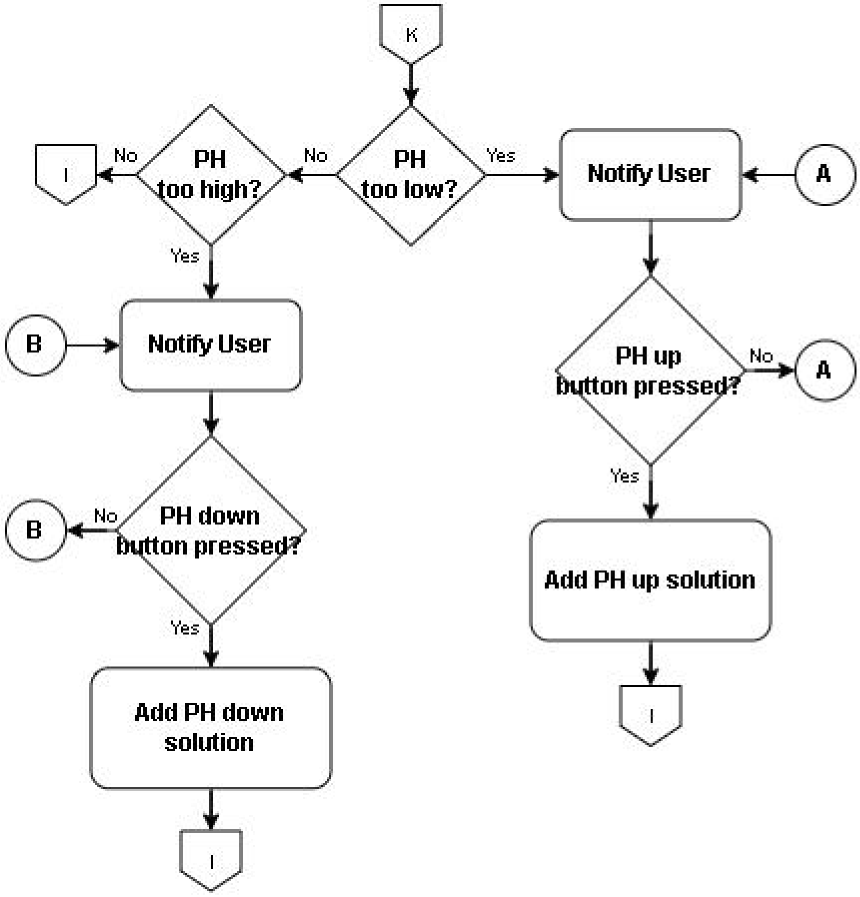

Figure 3.2.1.25. System Flowchart-Mobile: PH Desired Levels

Context Diagram

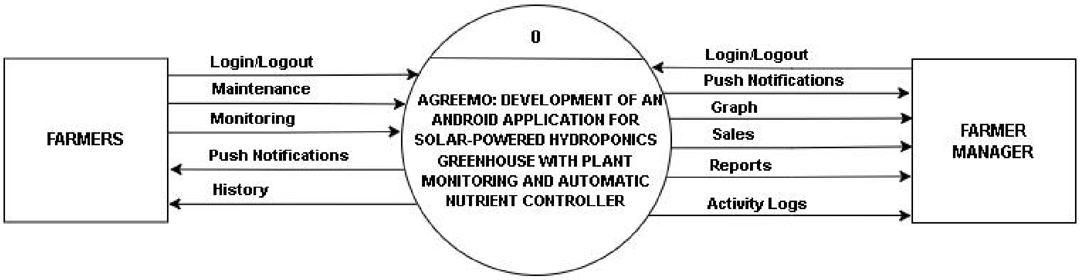

Figure 3.2.1.26. Context Diagram

Data Flow Diagram

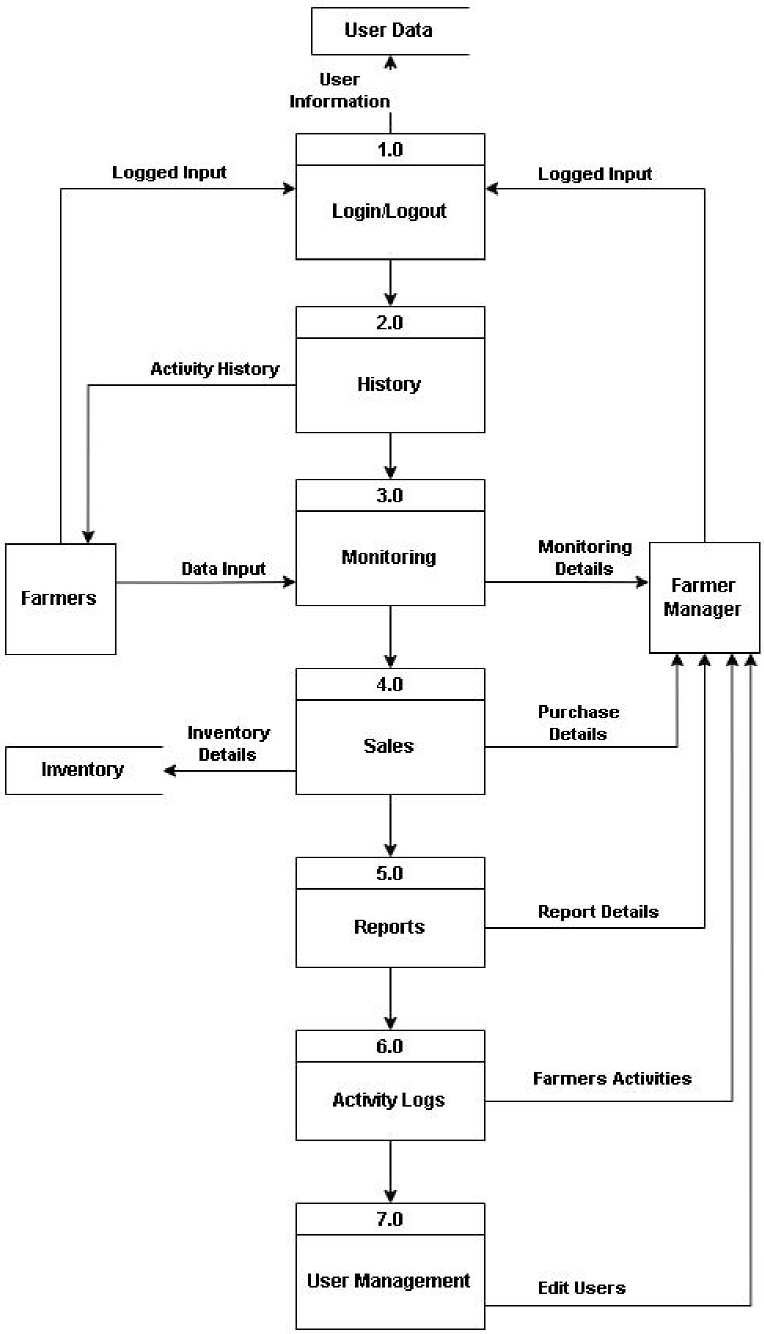

Figure 3.2.1.27. Data Flow Diagram Level 1

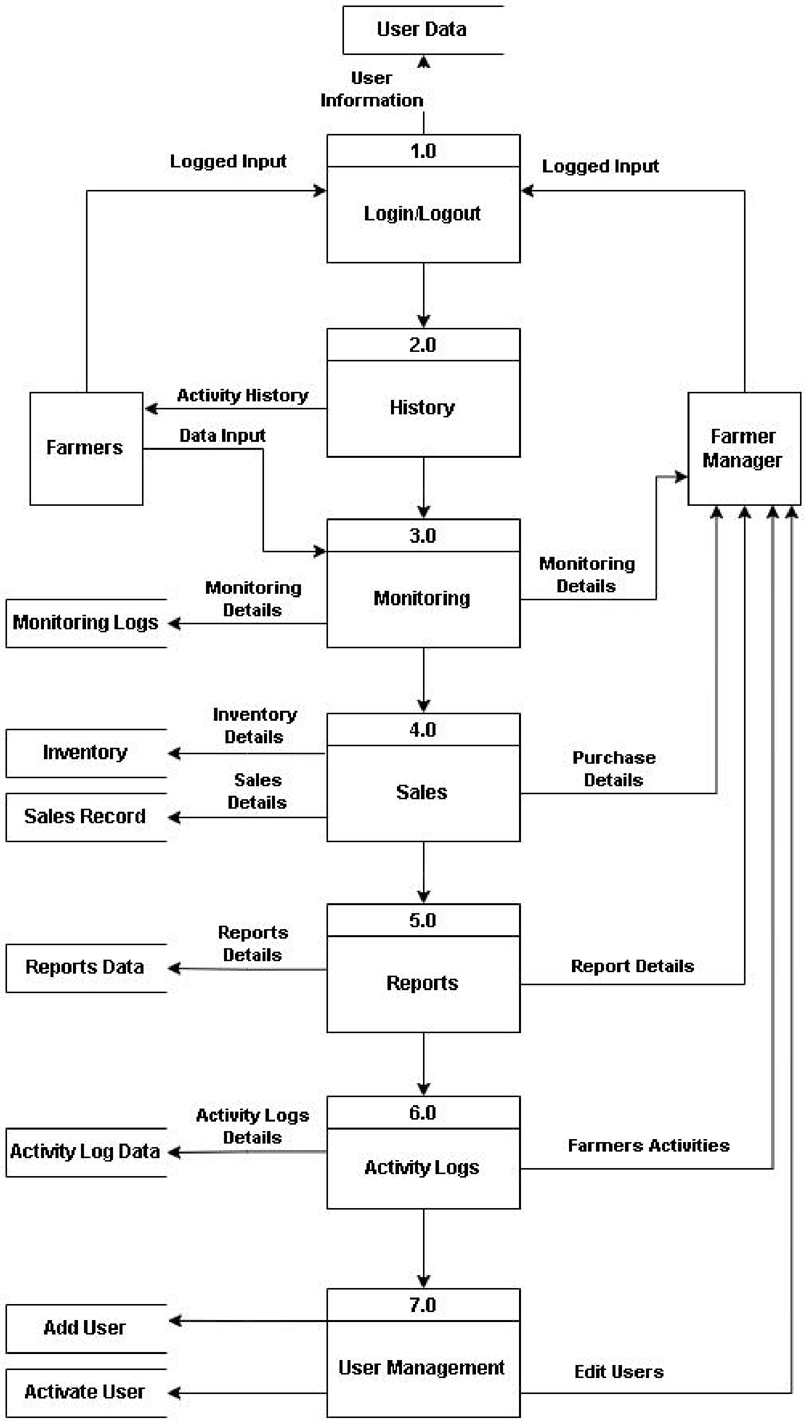

Figure 3.2.1.28. Data Flow Diagram Level 2

Use Case Diagram

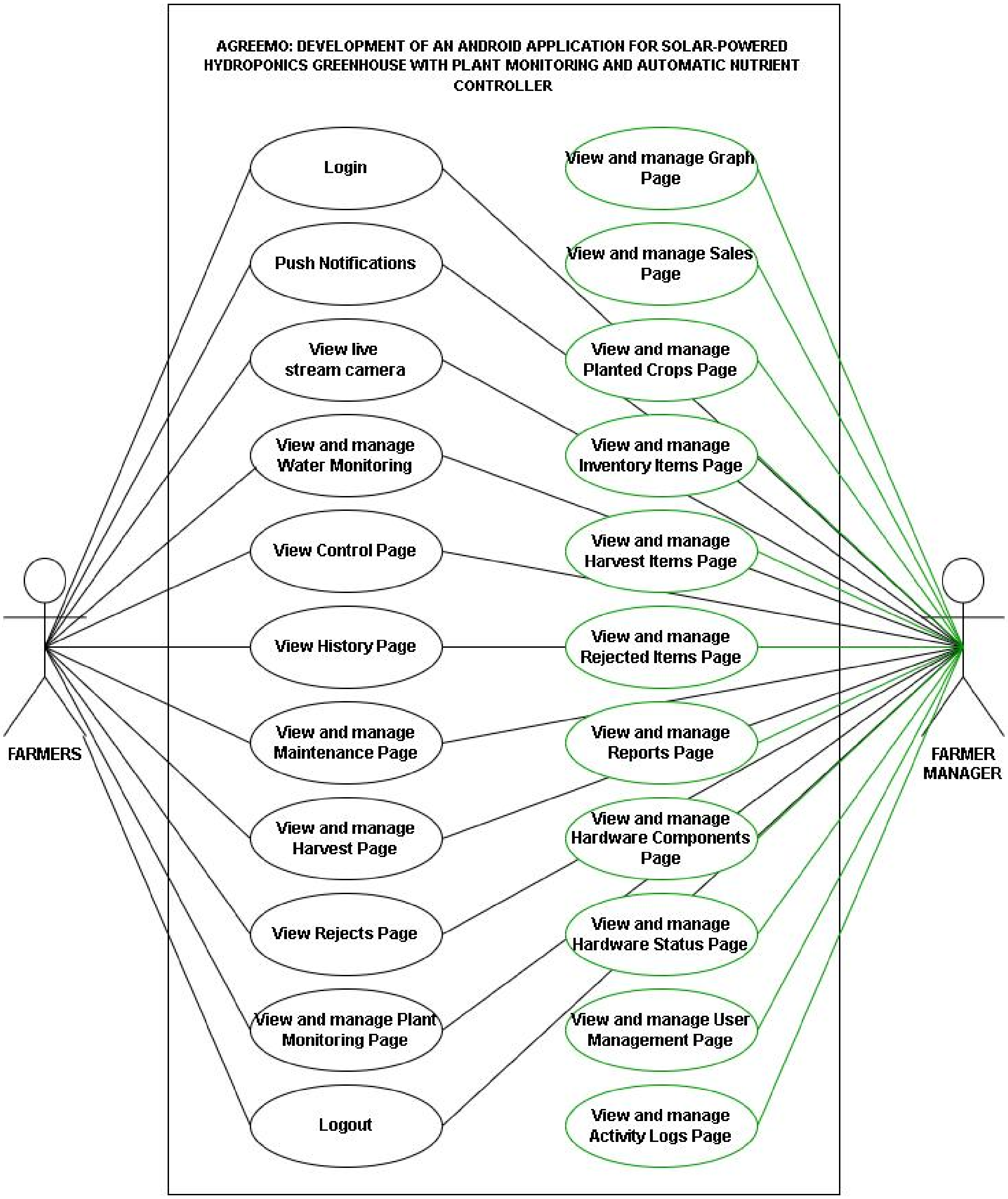

Figure 3.2.1.29. Use Case Diagram

Entity Relationship Diagram

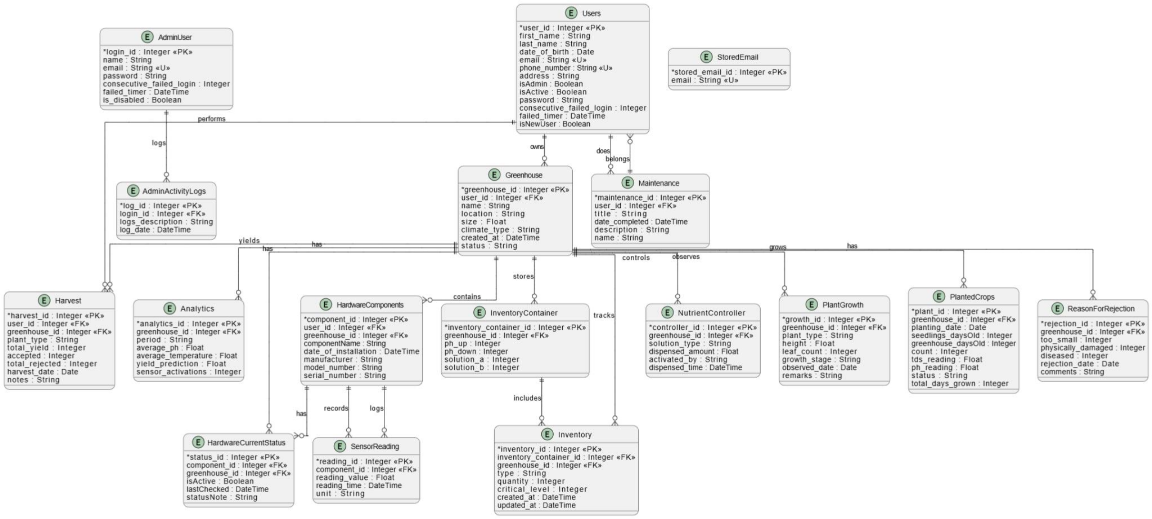

Figure 3.2.1.30. Entity Relationship Diagram

Site Map

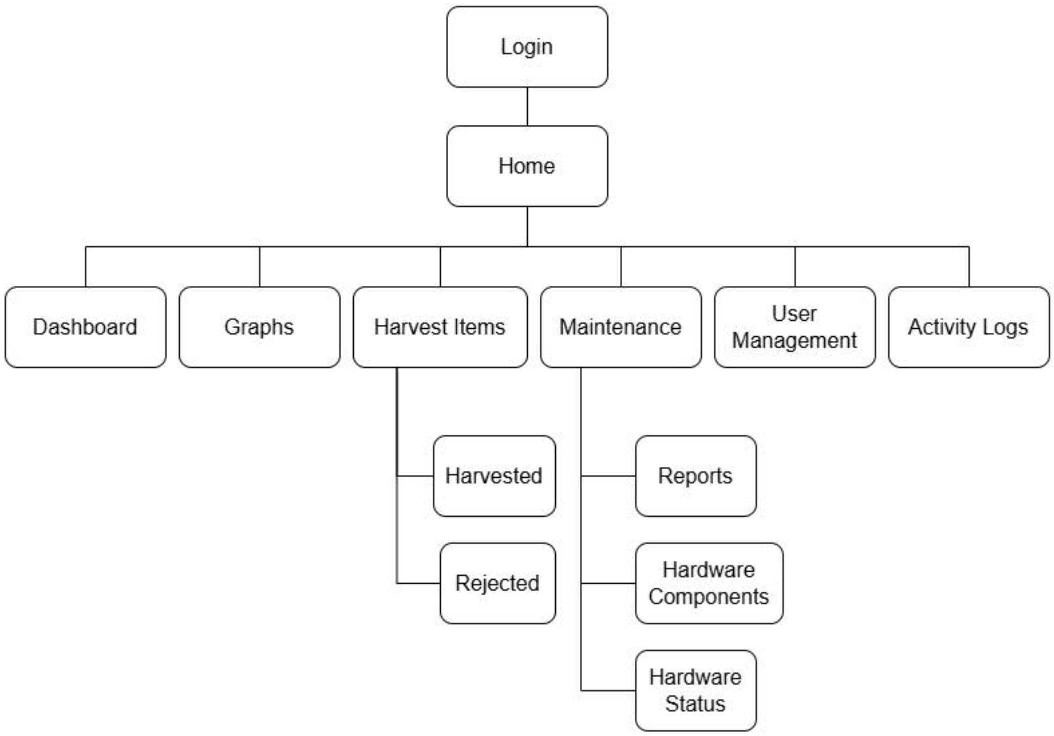

Figure 3.2.1.31. Site Map

Schematic Diagram

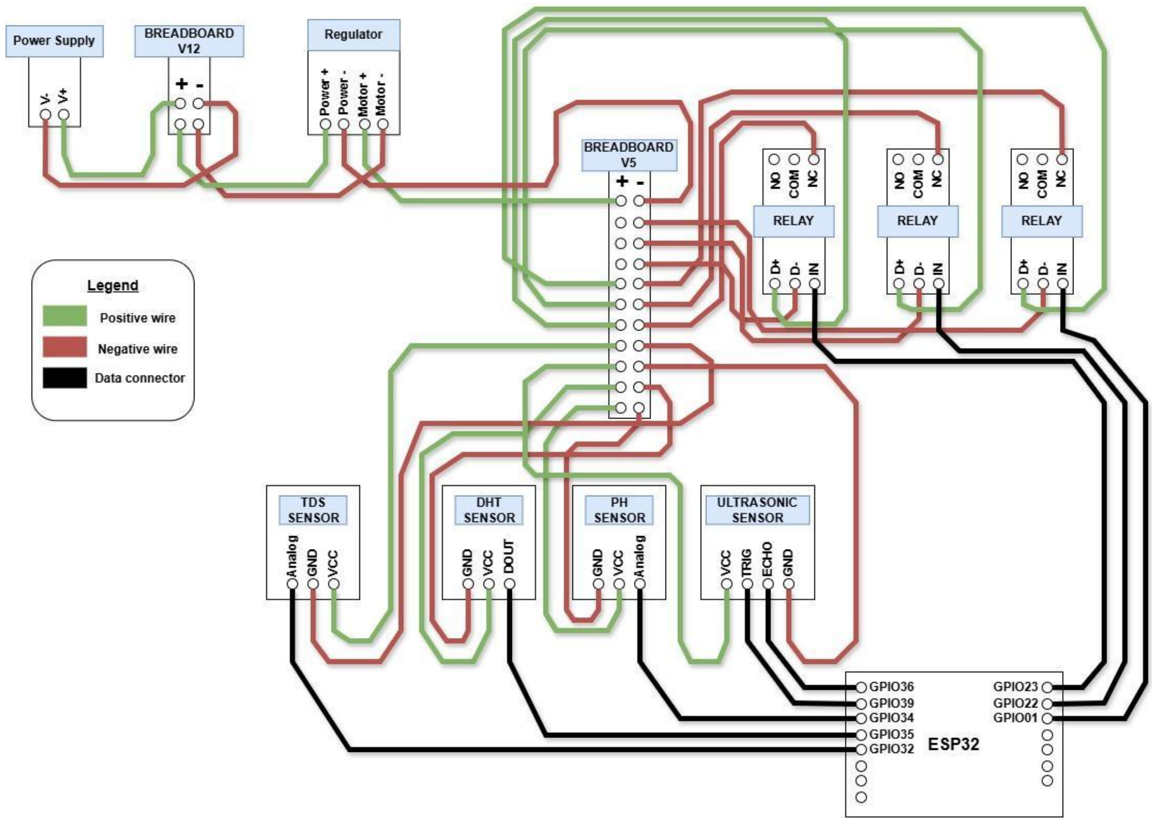

Figure 3.2.1.32. Schematic Diagram

Circuit Diagram

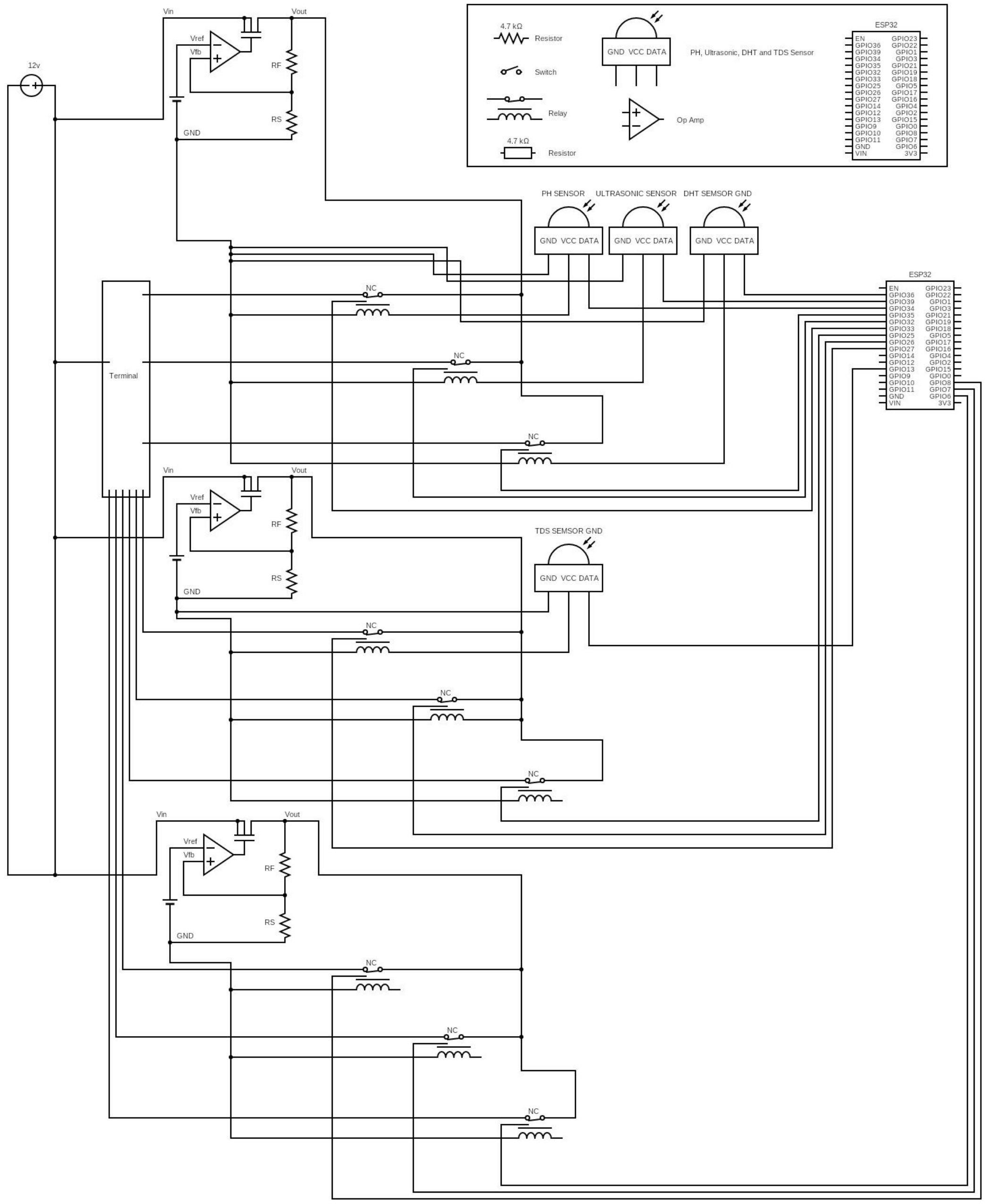

Figure 3.2.1.33. Circuit Diagram

Network Layout

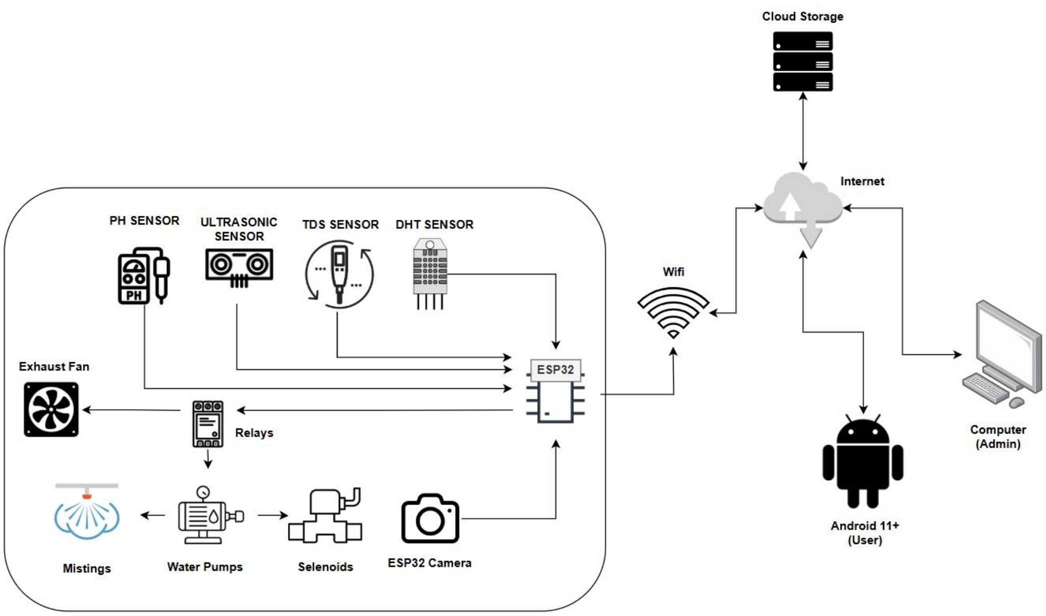

Figure 3.2.1.34. Network Layout

System Architecture

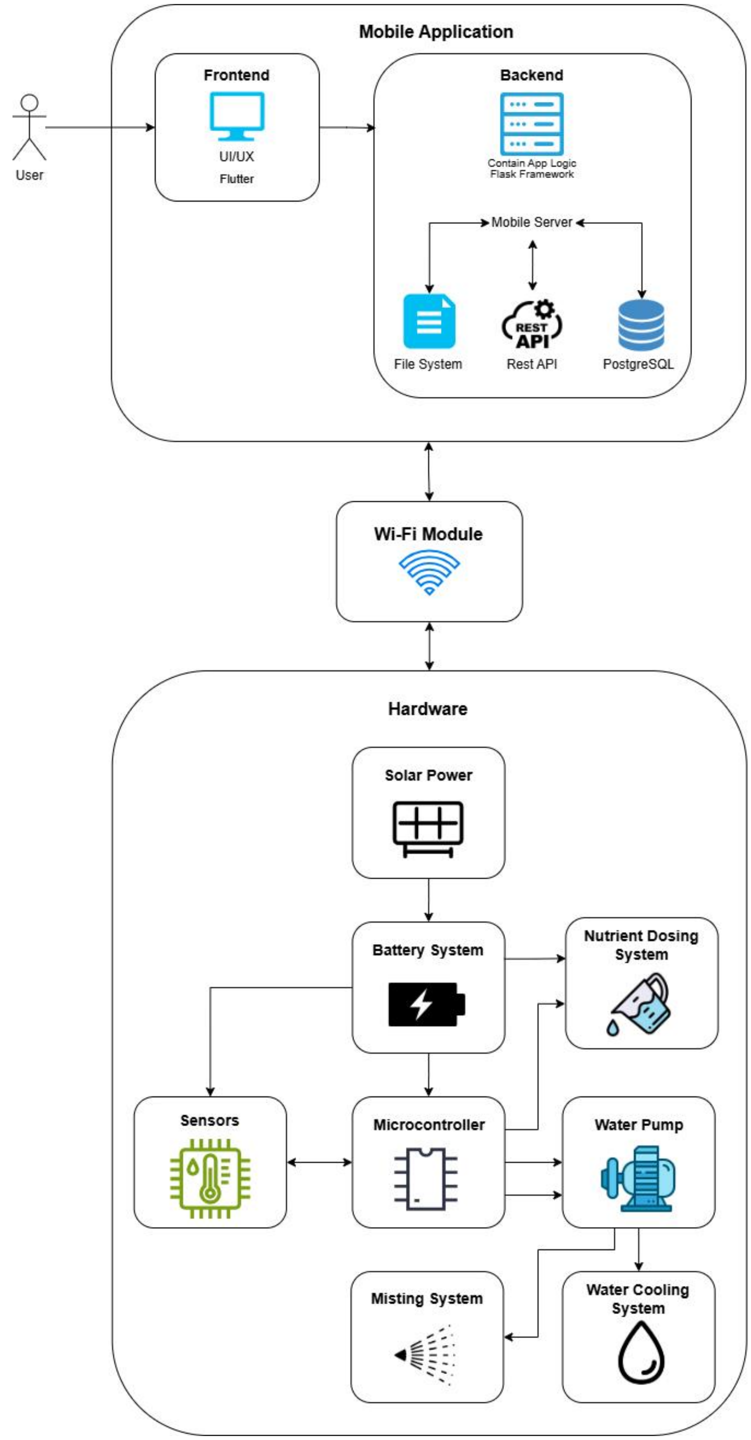

Figure 3.2.1.35. System Architecture

3.2.2 Proposed Project Development

Table 3.2.2.1 Proposed Project Development: Software

Quantity	Software	Description	Price
1	Render - Cloud Application Platform	Render is a cloud platform that simplifies the deployment of web applications and APIs. We use Render to host the web services that our AI integration use within our greenhouse prototype.	₱ 1,435
Total			₱ 1,435

Table 3.2.2.2 Proposed Project Development: Hardware 1

Quantity	Hardware	Description	Price
1	DC 6-80V BLDC 3-Phase DC Brushless Motor Controller 1600W 50A PWM Motor Driver	A robust and powerful motor controller designed to efficiently and precisely drive high-power BLDC motors in a wide range of industrial and high-power applications.	₱ 858

Table 3.2.2.3 Proposed Project Development: Hardware 2

Quantity	Hardware	Description	Price
1	ESP32 WiFi IoT Development Board with 30 and 38 pins	Utilizing the potent ESP32 microprocessor, this ESP-32 Development Board with 2.4 GHz ultra-low power dual-mode Wi-Fi	₱ 349
10	5*7 PCB Universal Board Experiment Matrix Circuit Board	General-purpose printed circuit board (PCB) designed for prototyping and experimenting with electronic circuits.	₱ 73
1	42.5 (Dia.) x H42.0mm, RS PRO 82dB Screw Mount Slow Pulse Piezo Buzzer, 60V ac/dc Min, 250V ac/dc Max.	The RS PRO Piezo Buzzer audio indicator are -30°C to +85°C and 60V ac/dc to 250V ac/dc	₱ 1,530

Table 3.2.2.4 Proposed Project Development: Hardware 3

Quantity	**Hardware**	**Description**	**Price**
1	Automatic Voltage Regulator (Servo Motor Control) KVA SVC-2KVA	Powerhouse Automatic Voltage Regulator safeguards against power fluctuations. Designed to stabilize voltage levels automatically, ensuring devices to operate smoothly and safely.	₱ 7,000
9	16 Channel 5V Relay Module, For Industrial Use, Current Output: 500 Ma	It can be directly controlled by microcontrollers such as Arduino, 8051, AVR, PIC, DSP, ARM, MSP430, and TTL logic.	₱ 2,880
6	Solenoid Controlled Water Valve 12V Water Solenoid Valve 12V G1/2 NC Water Dispenser Garden Spray Irrigation for Washing Machine	It uses an electromagnet (solenoid) to open or close the valve, allowing for precise electrical control of water flow.	₱ 1,254

Table 3.2.2.5 Proposed Project Development: Hardware 4

Quantity	Hardware	Description	Price
1	DFRobot Industrial Analog pH Sensor pH Meter Pro	This industrial pH electrode is made of a sensitive glass membrane with a low impedance.	₱ 3,990
1	Gravity: Arduino Analog TDS Sensor/Meter	Determines the nutrient concentration by measuring the total amount of dissolved solids in the nutrient solution.	₱ 862
7	Version of the Ultrasonic Distance Sensor HC-SR04 5V	It operates within the voltage range often associated with the Arduino product line, the Kitronik HC-SR04 5V ultrasonic distance sensor has been particularly selected.	₱ 1,337
3	Light sensor	Determines the intensity of the surrounding light.	₱ 192
1	Temperature and humidity sensor RS-WS-*-2D-EX	A device known as the RS-WS-*-2D-EX temperature humidity sensor has an accuracy of ±0.4°C (25°C) and ±2%RH (60%RH, 25°C) in measuring the temperature and relative humidity of the air.	₱1,203

Table 3.2.2.6 Proposed Project Development: Hardware 5

Quantity	Hardware	Description	Price
1	RO Industrial Water Purifier Machine 5000 L	Solids, bacteria, and algae all be eliminated by the RO industrial water purifier.	₱ 11,840
2	Omni Industrial Exhaust Fan 12" (XFV-300) , 14" (XFV-350) or 16" (XFV-400) Brix Industries Manila	Reduced vibration and less noise. motor that uses less electricity. enhances air circulation and offers a louder, more expansive air delivery.	₱ 5,000
1	220V 1L/min Fogger Machine High Pressure Fine Mist Maker Misting System Industrial Commercial Cooling Humidifier	The system utilizes a high-pressure pump to force water through specialized nozzles, creating a very fine mist or fog. This fine mist allows for rapid evaporation.	₱ 2,582

Table 3.2.2.7 Proposed Project Development: Hardware 6

Quantity	Hardware	Description	Price
1	VIVOSUN 800GPH Submersible Pump(3000L/H, 24W), Ultra Quiet Water Fountain Pump with 10ft. High Lift with 6.5ft. Power Cord, 3 Nozzles for Fish Tank, Pond, Aquarium, Statuary, Hydroponics Green	Maximum Flow Rate: 800 GPH (3000L/H); Maximum Lift Height: Up to 10 ft.; Power: 24W; Voltage: 110-120V, Adjustable Flow Rate. Up to 800 GPH is the maximum flow rate possible.	₱ 1,317
1	PWR-240-48 48V, 240W Din-Rail Power Supply (NDR-240-48)	The DIN Rail power supply units from the PWR series are reliable power sources for businesses that may encounter a range of environmental conditions and temperatures.	₱ 5,592
1	BOSCA 120w Monocrystalline Solar Panel with MC4 connector	Enables the system to run sustainably by converting sunlight into electricity.	₱ 2,779
1	XIAOMI Solar CCTV Camera Outdoor with Wifi 4G 20MP Auto Track Night Vision IP67 Waterproof Camera	A versatile, wireless, and robust surveillance camera designed for outdoor use, offering high-resolution video, smart tracking capabilities, and the convenience of solar power and 4G connectivity.	₱ 1,550

Table 3.2.2.8 Proposed Project Development: Hardware 7

Quantity	**Hardware**	**Description**	**Price**
1	300W power station	A portable power source that is probably utilized to power the system in places without easy access to the grid or as a	₱ 2,879
1	A 9L industrial water cooling system for the 40W CO2 Desktop Laser Carver Spacious and compact 2.4-gallon (9L) fuel	Spacious and compact 2.4-gallon (9L) fuel tankEasy to cool your machine while taking up very little space. Compatible with the K40 CO2 laser engraving machine (40W).	₱ 14,589
Total			₱ 69,656

3.2.3 Development and Testing

Development

The development process was carried out using an Agile approach, incorporating iterative cycles to ensure continuous improvement and integration of the system's components. The project was divided into specific milestones, each targeting a particular aspect of the greenhouse management solution. These included sensor integrations for pH, Total Dissolved Solids (TDS), water level, temperature, and humidity; the development of an image processing system using ESP32 cameras for plant growth tracking; and the creation of a user-friendly Android application for remote monitoring and control. Throughout this phase, collaboration with the Sunnyville Community Model Farm of Brgy. Pasong Tamo was essential to ensure that the system aligned with the farm's needs and sustainable practices.

A major component of the development was the integration of ESP32-based systems to manage sensor data and enable seamless communication with the Android application. The application provided real-time monitoring, allowing users to track and control various parameters such as pH levels, nutrient concentration, water levels, and environmental conditions inside the greenhouse. Additionally, the system featured automatic adjustments to optimize the plant's growing conditions by controlling nutrient levels and pH based on the specific requirements of the crops.

The solar-powered design was also a core feature, ensuring that the system operated independently, using renewable energy. The integration of solar panels provided power for the sensors, water pumps, and the cooling system, reducing the farm's reliance on external electricity sources and making the greenhouse eco-friendlier. Water filtration was another critical aspect, with a multi-stage purification system designed to ensure clean and safe water for plant growth.

Testing

The testing phase involved a rigorous validation process to confirm the reliability and performance of the system in various conditions. Functional testing was conducted to verify the accuracy and responsiveness of the sensors, including the pH, TDS, temperature, humidity, and water level sensors. The team also tested the Android application to ensure that it displayed real-time data correctly and facilitated smooth communication between the app and the ESP32-based system, allowing farmers to remotely monitor and manage the greenhouse.

Stress testing of the solar-powered system was also a key part of the testing phase. The team evaluated the system's performance under various weather conditions, ensuring that the solar panels provided sufficient energy throughout the day, with adequate battery backup for nighttime operations. The cooling system and automated responses for temperature and humidity control were tested to ensure that they activated correctly when predefined thresholds were exceeded.

Mobile Application

Login Form

Table 3.2.3.1 Login Form 1

Test Case	**Test Purpose**	**Test Condition**	**Expected Output**	**Actual Result**	**Remarks**
Creation of account	To determine whether the user is able to register an account using valid inputs.	All required fields such as first name, last name, email, phone number, birthdate, and address needs to input accurate information.	Creating an account.	The system will display “The account successfully created, please check your email”.	**Passed**
	To figure out when users are unable to register an account without completing every required field.	Need to fill all the textbox before proceeding. Table 3.2.3.1 Login Form	The account creation is not initiated due to lack of details.	The system displayed “Missing Please enter all the Information needed”	**Passed**

Table 3.2.3.2 Login Form 2

Test Case	Test Purpose	Test Condition	Expected Output	Actual Result	Remarks
	To confirm the uniqueness of each username submitted during registration.	The user attempts to register with a username that is already in use.	An already-used username prevents the creation of the account.	The “Email already exists.”	**Passed**
	To verify if the entered email is valid.		The login details will forward to the registered email.		**Passed**
Check if the “Email” and “Password” are correct	To confirm whether the user is able to access or operate the application.	If the user enters incorrect credentials.	An error message is displayed by the application.	Login Failed The Credentials Given Does Not Match Anything in the Database.	**Passed**
		If the credentials entered are correct or accurate.	The application will process the user account.	It will direct to the main page or dashboard.	**Passed**

Table 3.2.3.3 Login Form 3

Test Case	Test Purpose	Test Condition	Expected Output	Actual Result	Remarks
Creation of account	To determine whether the user is able to register an account using valid inputs.	All required fields such as first name, last name, email, phone number, birthdate, and address needs to input accurate information.	Creating account.	The system will display “The account successfully created, please check your email”.	**Passed**

Dashboard

Table 3.2.3.4 Dashboard

Test Case	Test Purpose	Test Condition	Expected Output	Actual Result	Remarks
User Profile (Upper left)	To view the users informatio n	Login is required to access the information .	Can view the users credentials with.	Show the User data such as Username, Email, Phone and the position.	**Passed**
GRH0 01 Conditi on (Green house Conditi on)	Temperat ure of humidity from Arduino		Temperatur e of greenhouse and Temperatur e of Humidity	Displays the actual temperature and humidity in Greenhouse.	**Passed**
Growth Monito ring	Tracking the plant growth.		The application can view and monitor the plant inside the Greenhouse .	Showing of Realtime video monitoring.	**Passed**

Navigation

Table 3.2.3.5 Navigation 1

Test Case	Test Purpose	Test Condition	Expected Output	Actual Result	Remarks
Water Monitoring	In order to regulate the amount of water in the container.	Can activate and deactivate the auto refill feature.	Able to control the reservoir water level.	The user may control and observe the water level in the container	**Passed**
	Specify the minimum and maximum pH levels and enable or disable the self-regulation feature.	pH acidity or alkalinity, ranging from 0(acidity) to 14(alkaline), with 7 being neutral.	Being able to regulate water's pH level.	The user can determine pH and water level.	**Passed**
			Able to set the target temperature in cooling.	The user has the ability select the target temperature for cooling.	**Failed**

Table 3.2.3.6 Navigation 2

Test Case	Test Purpose	Test Condition	Expected Output	Actual Result	Remarks
Harvest Tracker	To estimate the number of crops that will be lost and gathered.			A graph showing the total harvested, acceptable, rejected, and loss rate is included in the data summary. Additionally, the user can specify the number of accepted and rejected plants as well as the reasons for rejection.	**Passed**
History Data	To determine whether the plants are growing more slowly or as planned.	To see the history data the user will choose the “History” button		Every week, the application displays a graphic chart of the plant's growth.	**Passed**

Admin Website

Log-In Form

Table 3.2.3.7 Log In Form

Test Case	Test Purpose	Test Condition	Expected Output	Actual Result	Remarks
Input “Email” and “Password”	Check if the “Email” and “Password” are correct	If the user enters incorrect credentials.	An error message is displayed.	**Login Failed** The Credentials given does not match anything in Database.	**Passed**
		If the credentials entered are correct or accurate.	The system will process the account.	It will direct to the main page or dashboard.	**Passed**
Forgot Password	To check if the email is valid.	Enter the registered email.	The submitted email will receive a verification message.		**Passed**
	Reset password	Need to fill all the textbox before proceeding.		Enter the new password and the confirmation password	**Passed**

Dashboard

Table 3.2.3.8 Dashboard

Test Case	Test Purpose	Test Condition	Expected Output	Actual Result	Remarks
Harvests item “Harvested”	List and details of harvested items.	The user will click the filter button and choose the layout to sort the list.	Sorted list according to the chosen layout.	Overall view of harvested items including accepted, rejected, total yield and lose rate.	**Passed**
Harvests item “Rejected”	List and details of rejected items.	By selecting the layout and clicking the filter button, the user can sort the list.	arranged the list using the selected layout.	Overall view of rejected items including diseased, physical damaged and too small.	**Passed**
Reports	The users can report the problem or needs and maintenance.	The user will choose “report” button to see the report list	List of reported items.	Overall view of reports showing the	**Passed**

3.2.4 Implementation Plan

The capstone project implementation plan outlined AGREEMO, emphasizing the creation of a sustainable hydroponic greenhouse with application and monitoring system utilizing renewable energy. Essential elements comprise a real-time environmental monitoring application and the integration of renewable energy. The application would monitor temperature, humidity, water, and pH level, utilizing solar energy for electricity. The table below outlines strategies for ensuring successful deployment.

1. The proposed system should finish upon the agreed date between them, their mentor and beneficiary. The execution of each task in the system was dependent upon the proponents as long as they meet the required deadline of the university

2. Launching of prototype hydroponic greenhouse and monitoring application would be done by the Project Manager of AGREEMO with the whole team to ensure each function is working properly, and to consider how: the implementation can be scaled up or adapted over time.

3. A thorough assessment of hydroponic greenhouse and monitoring application performance could be accomplished by meticulous hardware testing and user evaluations with intended users. This evaluation would examine the system's obligation to execute its designated functions and verify its compliance with overall performance standards.

4. The proponents would furnish documentation and conduct training for the user of the proposed system to ensure individuals are proficient in the new process.

5. The proponents would conduct thorough monitoring of the proposed system to identify any potential faults or deviations from planned functioning. This procedure would perpetually gather and assess system performance data, facilitating the early identification of problems and the implementation of corrective measures as required.

Table 3.2.4.1 Implementation Plan 1

STRATEGY	ACTIVITIES	PERSON INVOLVED	DURATION	START DATE	END DATE
Requirements Gathering and Analysis	Meet with stakeholders, define greenhouse requirements, assess renewable energy options, gather user requirements	Project Manager, Analyst	3 weeks	October 10, 2024	October 31, 2024
System Design and Architecture	Design greenhouse layout, renewable energy systems, monitoring components, and software architecture	Designer, System Architect	4 weeks	November 1, 2024	November 29, 2024
Development and Implementation	Build greenhouse, integrate solar panels and sensors, develop monitoring software	Developers, Designer	9 weeks	December 1, 2024	January 31, 2025
Testing and Deployment	Test system for environmental accuracy, energy efficiency, deploy to selected location	QA Specialist	5 weeks	February 1, 2025	March 7, 2025

Table 3.2.4.2 Implementation Plan 2

STRATEGY	ACTIVITIES	PERSON INVOLVED	DURATION	START DATE	END DATE
User Training	Train stakeholders on greenhouse operation, maintenance, and monitoring	Trainer, Documentation Specialist	1 week	March 8, 2025	March 14, 2025
System Evaluation and Documentation	Collect feedback, prepare final documentation, handover to stakeholders	Project Manager, Documentation Specialist	1 week	March 8, 2025	March 14, 2025

Resource Allocation:

Table 3.2.4.3 Resource Allocation 1

Resource	Description	Allocated Personnel
Project Management	Oversee project planning, timeline, and resource coordination.	1 Project Manager, 1 Assistant Project Manager
Hardware Development	Design and build physical greenhouse, including renewable energy integration.	2 Hardware Engineers, 2 Assistants
Software Development	Develop monitoring software, data logging, and web interface.	2 Software Developers, 3 UI/UX Designers

Table 3.2.4.4 Resource Allocation 2

Resource	**Description**	**Allocated Personnel**
Data Analysis	Monitor and analyze environmental data from sensors.	1 Data Analyst, 1 Assistant Data Analyst
Quality Assurance	Test system components for accuracy, reliability, and efficiency.	2 QA Specialists
Training and Support	Train stakeholders on system usage, provide ongoing support.	1 Trainers, 1 Support Specialist
Documentation	Prepare user manuals, system documentation, and final reports.	2 Documentation Specialist
Logistics and Procurement	Handle material procurement and logistics for greenhouse setup.	1 Logistics Coordinator

CHAPTER 4

RESULTS AND DISCUSSION

Results and Discussion interprets and presents the development's result including the implementation of the AGREEMO system, aligned with the project's five core objectives. Each section corresponds to a specific objective and discusses the system's technical performance, user feedback, and functional validation. The data was gathered through testing of the prototype, surveys based on ISO 25010 standards, and observation of farmer interactions with both the Android and web applications. The findings demonstrate how AGREEMO addresses the challenges of manual hydroponics farming, integrating automation, renewable energy into an efficient, and integration of Internet of Things (IoT) technologies for a farmer-friendly system.

4.1 Prototype Development

The hydroponic greenhouse at Sunnyville Community Model Farm encountered various operational and environmental challenges that the AGREEMO system aimed to address. The list below outlines the problems identified during interviews and field observations and how the system responded to each based on project implementation:

4.1.1 Manual Nutrient Monitoring and Inconsistent TDS Levels

- The farm manually adjusted nutrients based on daily checks of the water reservoir, which were prone to inaccuracy and delays.
- AGREEMO automated nutrient control through real-time TDS monitoring and dispensing of Solution A & B, improving consistency and reducing manual workload.

4.1.2 Uncontrolled Temperature Inside the Greenhouse

- High temperatures, especially during the dry season, affect lettuce growth due to lack of automatic climate regulation.
- The system introduced automated misting and water cooling features that activate when temperatures exceed 30°C, stabilizing the growing environment.

4.1.3 Manually Adjusted pH Levels

- Maintaining pH within the optimal range was done manually, requiring frequent farmer attention and adjustments.
- AGREEMO integrated pH sensors and automatic pH Up/Down dispensing to maintain ideal levels without manual checking.

4.1.4 Unmonitored Water Levels in Tanks

- Overfilling or empty nutrient tanks disrupted irrigation schedules and nutrient delivery.

- Ultrasonic sensors were added to track water levels and send app alerts when refills are needed, preventing disruption in plant care.

4.1.5 Inconsistent Plant Growth Monitoring

- Lettuce growth was tracked visually by farmers, which led to inconsistent harvest timing and missed quality benchmarks.
- The Android application incorporated AI-powered image recognition to assess lettuce maturity and notify farmers when crops are ready for harvest, ensuring proper timing and crop quality.

4.1.6 Manual Record-Keeping and Data Logging

- All harvest data, user activity, and inventory tracking were done manually by the farm manager.
- AGREEMO’s web application provided automated reporting, centralized data logs, and visualization tools to simplify decision-making and improve farm operations.

The problems encountered by Sunnyville Community Model Farm in their hydroponic greenhouse were thoroughly evaluated and addressed through the development of the AGREEMO system. Most challenges—ranging from nutrient monitoring and environmental control to plant growth tracking—were resolved through automation, resulting in improved efficiency, reduced manual labor, and better crop management. The integration of IoT sensors, mobile alerts, and AI technologies enabled the farm to transition from manual to smart farming processes tailored for urban settings.

4.2 Functional Testing and Integration of the Automated Greenhouse Prototype

This section presents the outcome of the development and testing of the solar-powered hydroponics greenhouse prototype. To monitor and regulate key environmental parameters and water parameters necessesary for optimal lettuce cultivation, the prototype integrates automation and IoT technologies. Emphasis was placed on ensuring sustainability through solar energy and rainwater utilization, and on automating critical greenhouse functions.

The hydroponics greenhouse prototype was successfully constructed using ESP32 microcontrollers, integrated sensors, and a solar panel-battery power source. The system automates monitoring and controlling critical parameters like humidity, pH, temperature, and TDS, while using rainwater filtered into a reservoir for irrigation.

Key results:

- The misting and exhaust systems were automatically triggered at 22°C and deactivated at 20°C, demonstrating the system’s ability to regulate greenhouse temperature.

Ultrasonic sensors accurately detected low water levels in irrigation and solution reservoirs and sent timely alerts for manual refilling.

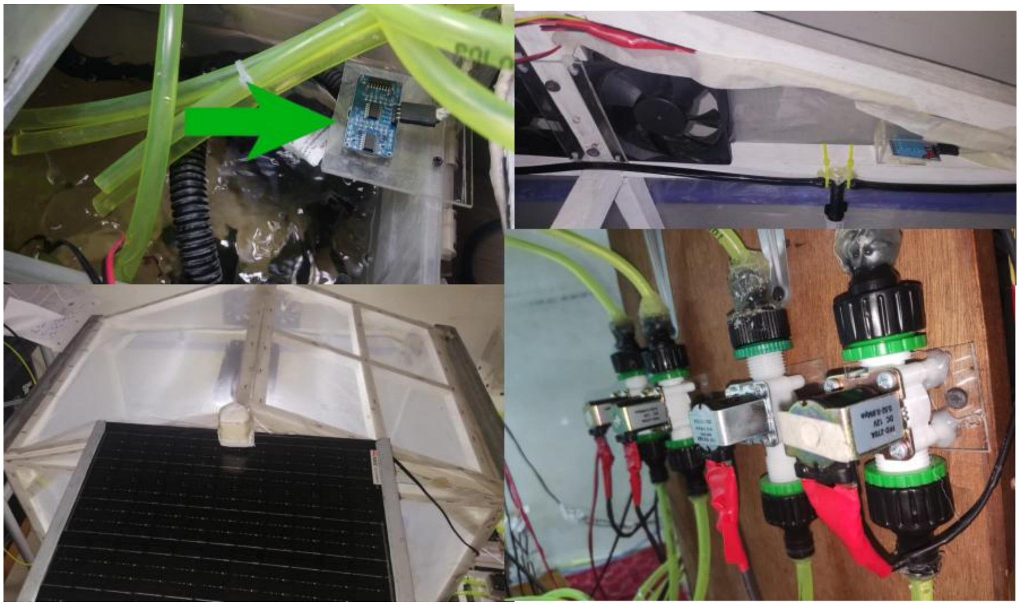

Figure 4.1 Prototype of Actual Picture

4.3 Structural Design and Environmental Sustainability of the Greenhouse

This section outlines the structural and environmental design of the hydroponic greenhouse specifically intended for lettuce cultivation. The design focused on maintaining optimal conditions by integrating solar-powered components, automated monitoring systems, and a rainwater collection mechanism. These enhancements aimed to create a sustainable and low-maintenance environment that supports healthy crop growth and minimizes manual intervention.

The greenhouse was tailored for optimal lettuce cultivation through environmental tuning and integration of sustainable systems like solar power and rainwater collection. The design supported a healthy and consistent growing environment.

Key results:

- pH levels were maintained between 5.8 and 6.2, and TDS ranged from 600 to 800 ppm, aligning with optimal conditions for lettuce.
- Lettuce seedlings exhibited noticeably improved growth, with visual signs of health observed across Day 1, Day 5, and Day 10.
- Farmers reported fewer manual adjustments, thanks to accurate real-time monitoring and automated alerts.

Figure 4.2 Lettuce Seeding Improved Growth

4.4 Android Application

This section highlights the development and functionality of the Android Application designed for farmers to collaborate within automated system hydroponics. Mobile Application acts as a primary interface forr real-time monitoring, manual control, and AI-powered crop assessment. By integrating key technologies such as YOLOv8 for plant detection and OneSignal for notifications, the app enhances farmer efficiency and decision-making through a mobile platform.

The Android Application was developed to enable control and monitoring of real time for farmers. The App is connected directly to IoT hardware system, built using the OpenCV, YOLOv8, and integrated with OneSignal for notifications.

Key results:

- Farmers were able to monitor greenhouse conditions live, including pH, TDS, humidity, and water levels.
- Push notifications were successfully received, alerting farmers about low water levels and lettuce harvest readiness.
- AI-based lettuce recognition achieved a 78% accuracy rate, effectively distinguishing ready-for-harvest crops.

Manual control features were functional, allowing users to trigger misting, ventilation, and nutrient dispensing through the app interface.

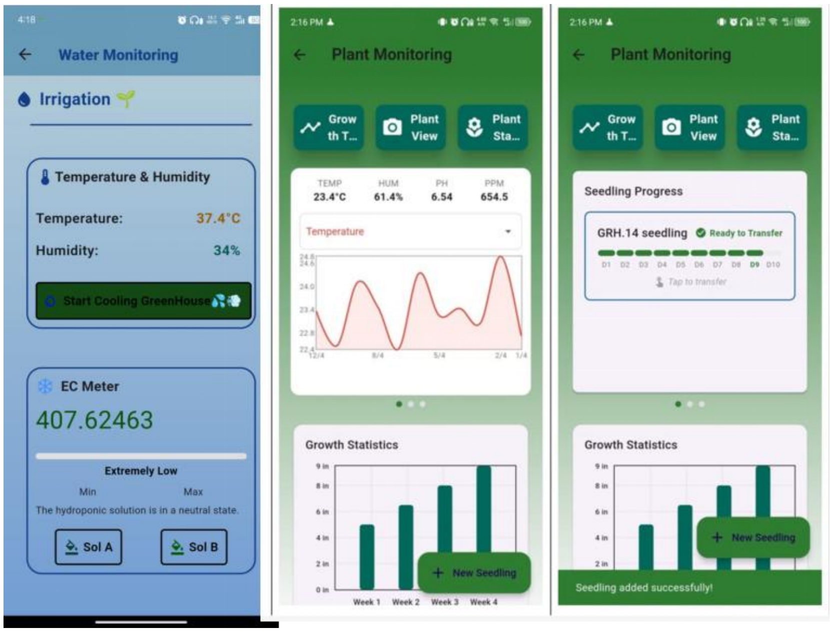

Figure 4.3 Plant Growth Monitoring

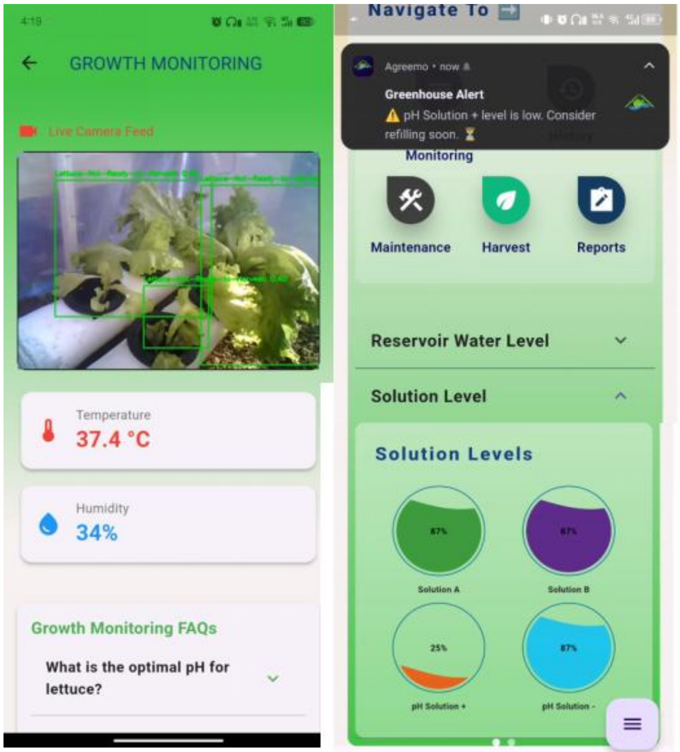

Figure 4.4 AI Model Harvest Detection, Ph and Nutrients Level Monitoring

4.5 Web Application

This section discusses the development and features of the web-based application tailored for farm managers. The platform was designed to provide centralized oversight of greenhouse operations, streamline reporting, and enhance user and inventory management. With built-in data visualization and account control features, the web app complements the Android application by offering a broader management interface and administrative functions.

The web-based dashboard was designed for the farm manager to oversee farm activities, manage users, and generate data-driven reports. It processed and visualized real-time and historical greenhouse data.

Key results:

- Crop reports and rejected harvest summaries were visually displayed using graphs and tables.
- User activity and hardware logs were automatically updated, improving managerial oversight.
- User management, account creation, and system access controls were integrated and functional.

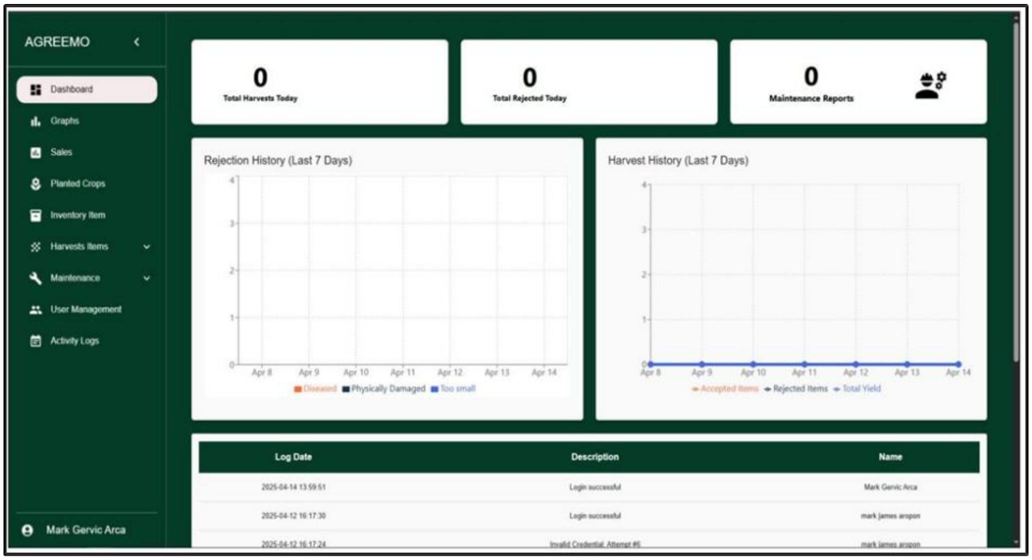

Figure 4.5 Web Homepage

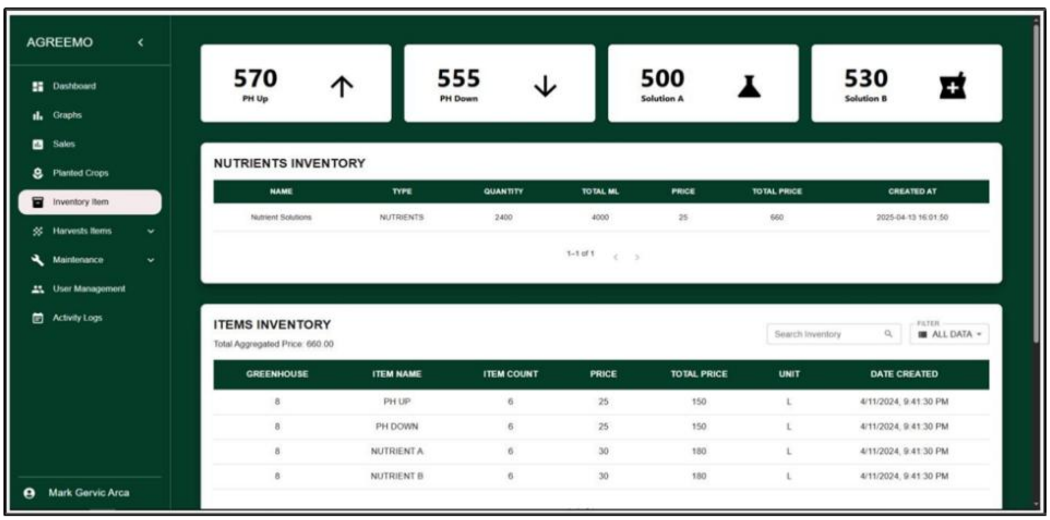

Figure 4.6 Inventory Management

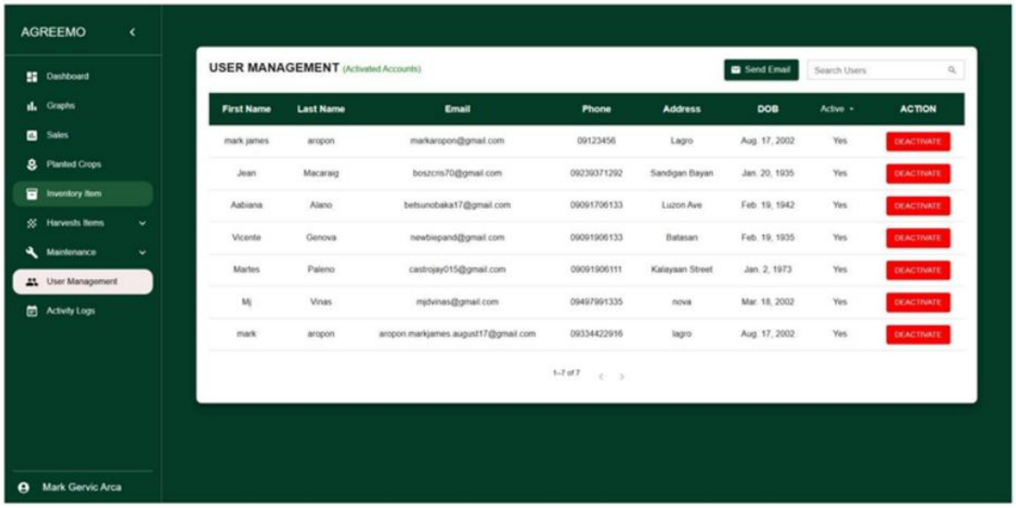

Figure 4.7 User Management

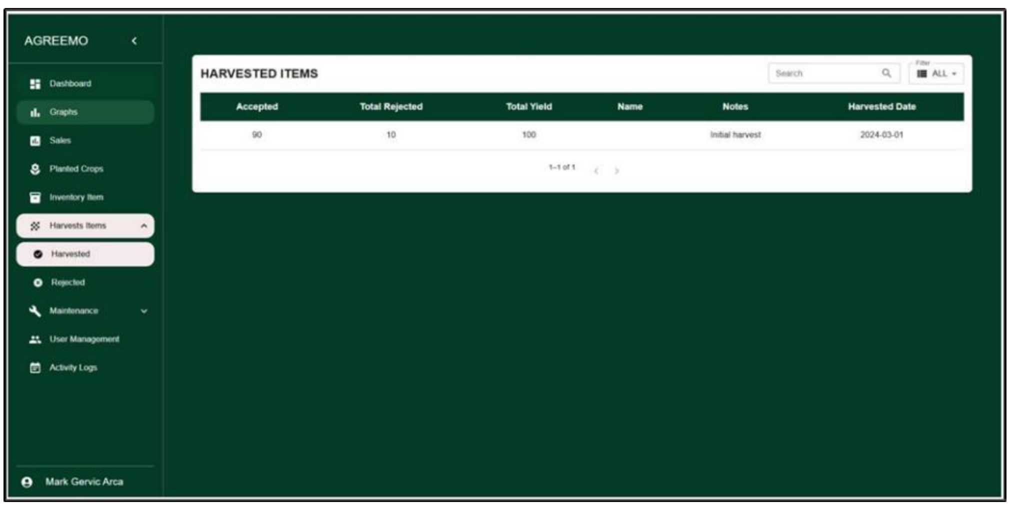

Figure 4.8 Activity Logs

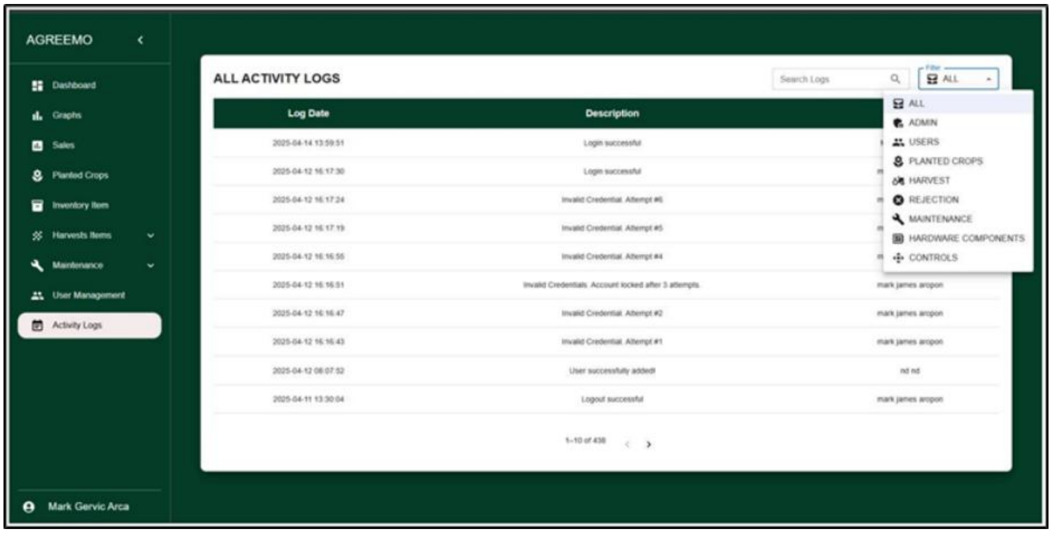

Figure 4.9 Hardware Components

4.6 System Evaluation

This section discusses the system evaluation results from ISO 25010-based software quality model. The evaluation aimed to assess the Android application's overall quality in terms of functionality, usability, compatibility, reliability, and security.

To measure the effectiveness and user satisfaction of the mobile application, feedback was gathered from key stakeholders, including farmers, agriculturists, and experts.

The Android application was evaluated using ISO 25010 software quality standards through a Likert-scale survey. Twenty respondents—including farmers and agriculturists participated in the evaluation.

Key results:

- Functionality received a weighted mean of 4.0 (Satisfied)
- Usability rated highest at 4.1 (Satisfied)
- Reliability also scored 4.0 (Satisfied)
- Compatibility received 3.9 (Satisfied), with concerns on device limitations (only Android 11 and up)
- Security rated 3.9 (Satisfied), suggesting room for further enhancement

Overall, the system achieved an average score of 3.9 across all ISO criteria, reflecting consistent satisfaction with performance, although future improvements are needed in backward compatibility and offline capabilities.

Table 4.1 Profile of Participants.

Participants	**Frequency**
Sunnyville Workers	10
Agriculturists	10
Total	20

Table 4.1 shows 20 respondents from Sunnyville workers and agriculturists, 10 from Sunnyville and another 10 from the agriculturists.

Table 4.2 Likert Scale Weighted Mean Interval

Mean Interval	**Verbal Interpretation**
1 - 1.80	Strongly Dissatisfied
1.81 - 2.60	Dissatisfied
2.61 - 3.40	Neutral
3.41 - 4.20	Satisfied
4.21 - 5.00	Strongly Satisfied

The formula of the Likert Scale Interval based on Lindner, J. R., & Lindner, N. (2024) is Interval = (Greatest Value - Lowest Value) / Number of Scores.

Table 4.3 Weighted Mean, Verbal Interpretation, and

Questions for Functionality based on Sunnyville Workers

Functionality	**Weighted Mean**	**Verbal Interpretation**
1. How effectively does the application allow you to remotely monitor and control the greenhouse environment (temperature, humidity, etc.)?	4.0	Satisfied
2. How well does the app integrate and display data from multiple sensors simultaneously?	4.0	Satisfied
3. How useful are the data history logs and reports in managing the farm and making informed decisions?	4.4	Strongly Satisfied
4. How well does the application's automated nutrient controller meet your needs in maintaining the health of the lettuce plants?	3.6	Satisfied
Total Weighted Mean	4.0	Satisfied

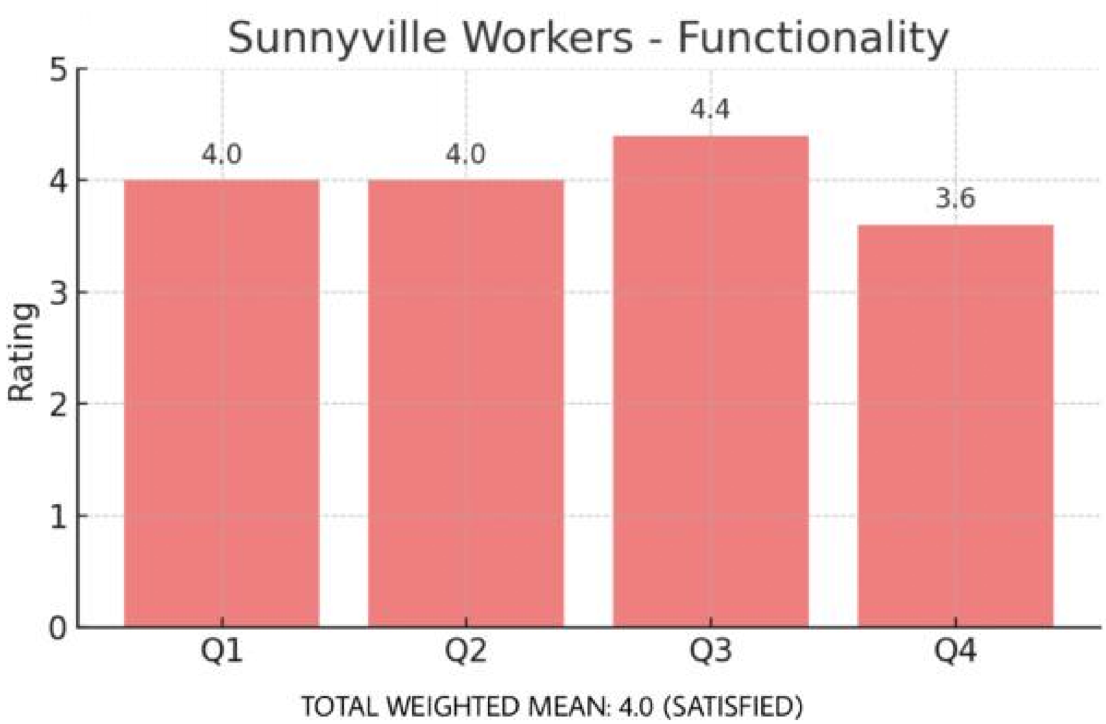

Figure 4.10 Sunnyville Workers-Functionality

Figure 4.10 represents the workers' perspective on the system's functionality. The first and second questions received the second-highest weighted mean of 4.0 and had an interpretation of 'Satisfied. While the third question received the highest weighted mean of 4.4 and had an interpretation of 'Strongly Satisfied'. The fourth question received the lowest weighted mean of 3.6 and had an interpretation of 'Satisfied'.

The total weighted mean of four questions is 4.0 with a verbal interpretation of 'Satisfied'. The results support specific objective numbers one, three, and four. This highlights the ability of the system to deliver to users its functionality, which is monitoring and controlling the hydroponics greenhouse by displaying real-time data and functionalities from the application and data visualization for farmer managers.

Table 4.4 Weighted Mean, Verbal Interpretation, and Questions for Compatibility based on Sunnyville Workers

Compatibility	**Weighted Mean**	**Verbal Interpretation**
1. How well does the application perform on the devices you use (smartphone, tablet, computer)?	3.9	Satisfied
2. How satisfied are you with the application's ability to maintain a stable connection with the database, sensors, and devices?	4.2	Satisfied
3. How often do you experience compatibility issues with the app on your devices?	3.7	Satisfied
4. Does the app offer a consistent user experience across different devices?	3.5	Satisfied
Total Weighted Mean	3.8	Satisfied

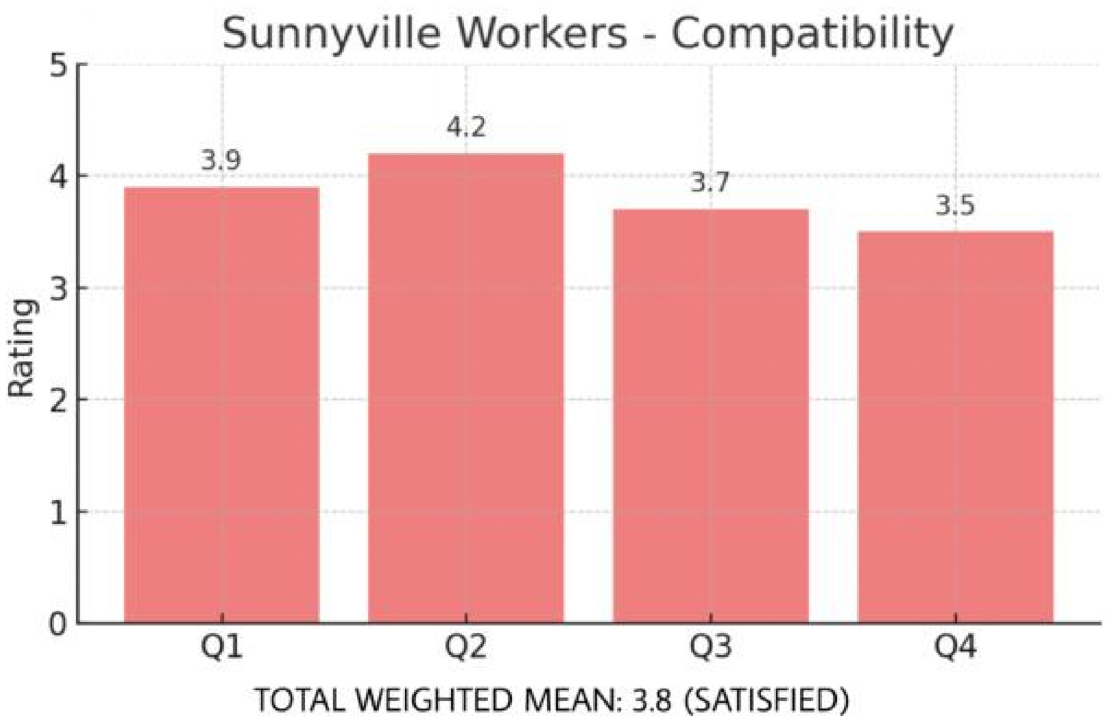

Figure 4.11 Sunnyville Workers-Compatibility

Figure 4.11 represents the workers' perspective on the system's compatibility. The first question received the second highest mean of 3.90 with a verbal interpretation of 'Satisfied'. The second question received the highest weighted mean of 4.2 with a verbal interpretation of 'Satisfied'. The third question gained the second lowest a weighted mean of 3.7 with a verbal interpretation of 'Satisfied'. The fourth question received the lowest weighted mean of 3.5 with a verbal interpretation of 'Satisfied'.

All four questions have a total weighted mean of 3.8, which has a verbal interpretation of 'Satisfied'. The result supports objective numbers three and four, which allows the farmers to monitor plant growth and control greenhouse functions in real-time and allow the farmer manager to view a summary of data visualization. Users are satisfied with the app's performance on their devices and they rate its stable connection with the database and sensors highly. Compatibility issues are minimal, meaning the app works well across platforms.

Table 4.5 Weighted Mean, Verbal Interpretation, and Questions for Usability based on Sunnyville Workers

Usability	**Weighted Mean**	**Verbal Interpretation**
1. How easy is it to navigate and use the application's interface for viewing reports, and controlling the greenhouse?	4.1	Satisfied
2. How clear and informative are the data visualizations and reports generated by the application?	4.2	Satisfied
3. How efficient is the app in allowing you to perform your farm management tasks?	4.1	Satisfied
Total Weighted Mean	4.1	Satisfied

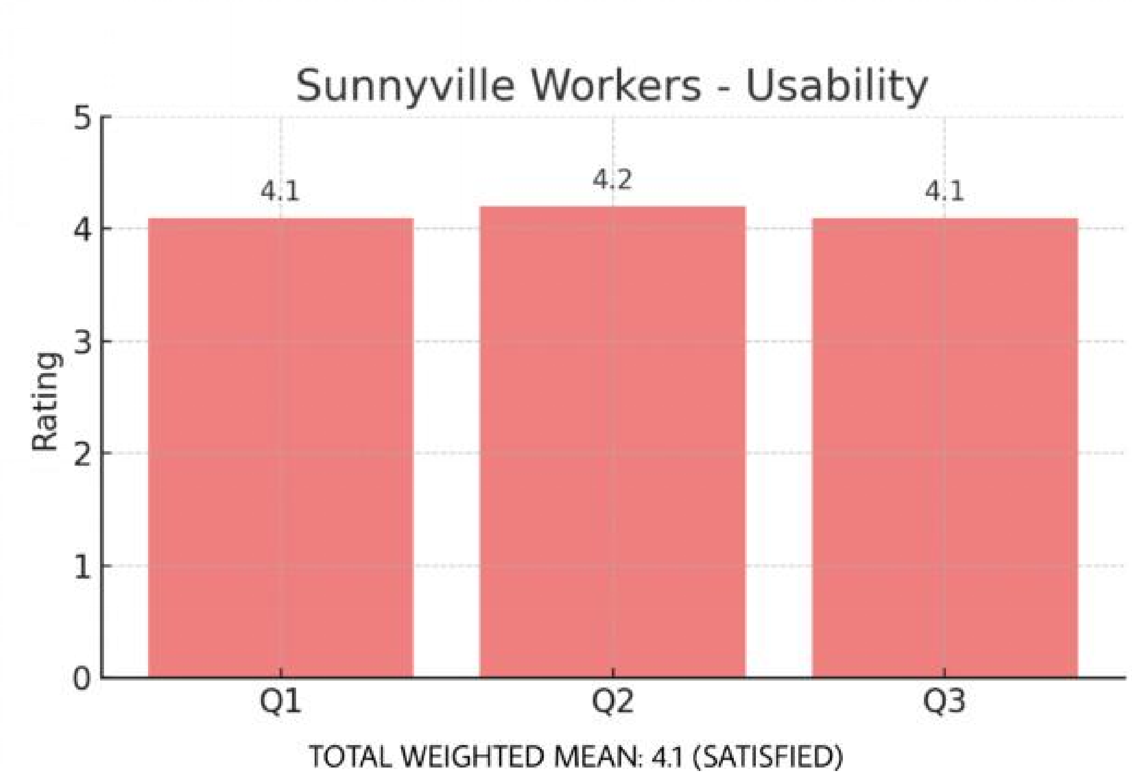

Figure 4.12 Sunnyville Workers-Usability

Figure 4.12 represents the workers' perspective on the system's Usability. The first and third questions gained the second highest weighted mean of 4.1, with a verbal interpretation of 'Satisfied'. the second questions gained the highest weighted mean of 4.2 with a verbal interpretation of 'Satisfied'.

All three questions have a total weighted mean of 4.1 with a verbal interpretation of 'Satisfied'. The result supports specific objectives number one to four, which emphasize the ability of the system to provide an easy-to-understand interface for the users. It allows them to navigate with ease and provide data visualization to interpret raw data from the sensors.

Table 4.6 Weighted Mean, Verbal Interpretation, and Questions for Reliability based on Sunnyville Workers

Reliability	**Weighted Mean**	**Verbal Interpretation**
1. How reliable is the application in providing continuous monitoring and control of the hydroponic greenhouse?	3.9	Satisfied
2. How satisfied are you with the app's performance in automating tasks and alerts?	4.1	Satisfied
3. How confident are you in the accuracy of the data provided by the app?	4.2	Satisfied
Total Weighted Mean	4.0	Satisfied

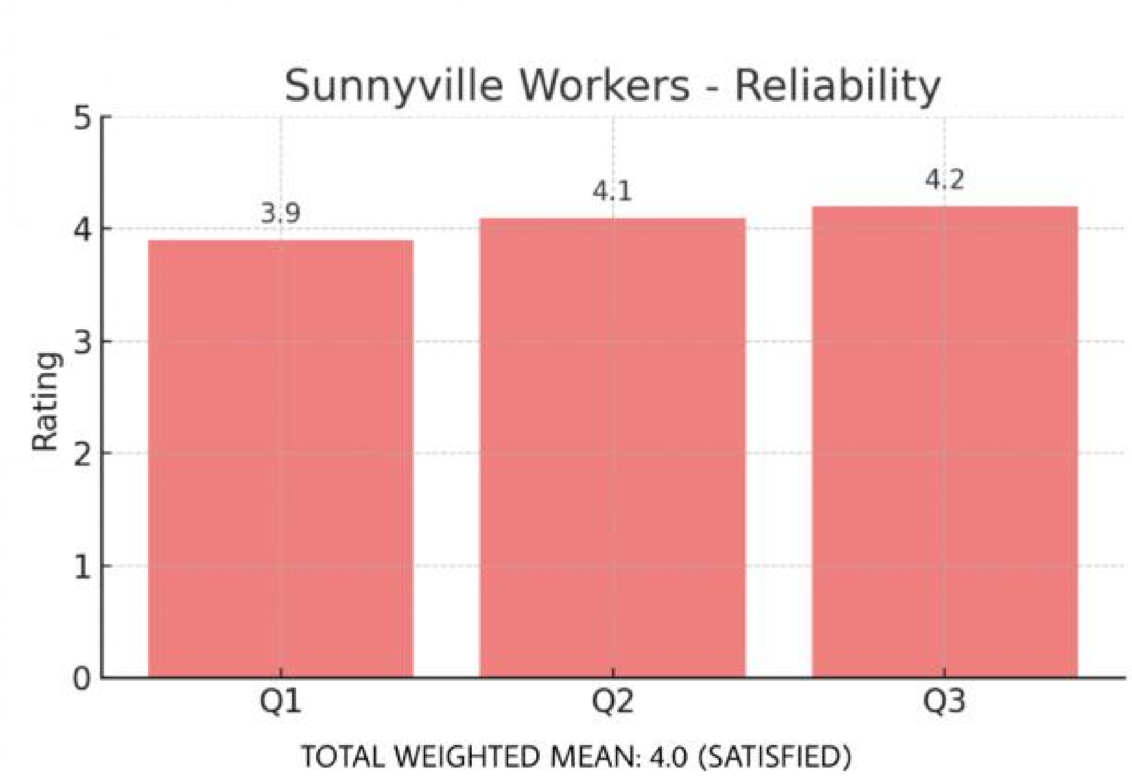

Figure 4.13 Sunnyville Workers-Reliability

Figure 4.13 represents the workers' perspective on the system's Reliability. The first question gained a lowest weighted mean of 3.9 with a verbal interpretation of 'Satisfied'. The second question gained a weighted mean of 4.1 with a verbal interpretation of "Satisfied". The third question gained the highest weighted mean of 4.2 with a verbal interpretation of "Satisfied".

All three questions have a total weighted mean of 4.0, with a verbal interpretation of 'Satisfied'. The result supports specific objectives number one and three, which emphasizes the ability of the system to provide satisfactory reliability to the user by providing continuous monitoring and control of the hydroponic greenhouse and accurate real-time data.

Table 4.7 Weighted Mean, Verbal Interpretation, and Questions for Security based on Sunnyville Workers

Security	**Weighted Mean**	**Verbal Interpretation**
1. How secure do you feel about the farm's data within the application?	3.8	Satisfied
2. How effective are the application's security measures in preventing unauthorized access to sensitive farm information?	4.0	Satisfied
3. How satisfied are you with the application's handling of user access and permissions?	4.1	Satisfied
Total Weighted Mean	3.9	Satisfied

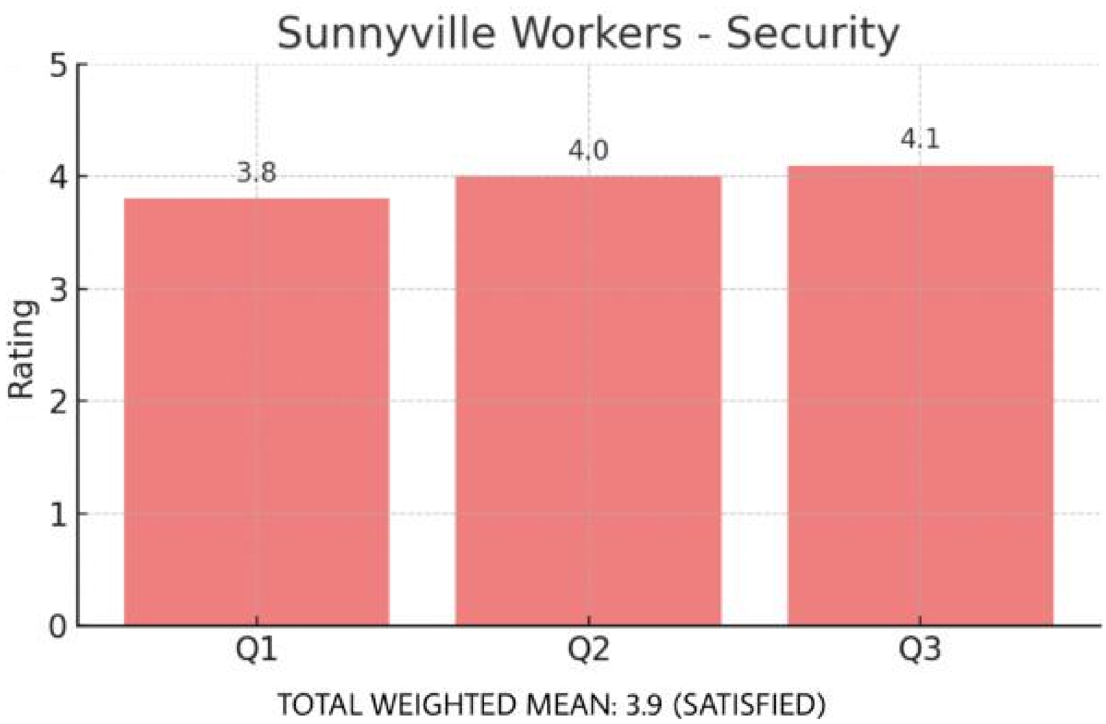

Figure 4.14 Sunnyville Workers-Security

Figure 4.14 represents the workers' perspective on the system's Security. The first question gained the lowest weighted mean of 3.8 with a verbal interpretation of 'Satisfied'. The second question gained a weighted mean of 4.0 with a verbal interpretation of 'Satisfied'. The third question gained the highest weighted mean of 4.1 with a verbal interpretation of 'Satisfied'.

All three questions have a total weighted mean of 3.9 with a verbal interpretation of 'Satisfied'. The result emphasizes the ability of the system to provide satisfactory security measures by preventing unauthorized access to sensitive farm information and handling user access and permissions.

Table 4.8 Weighted Mean, Verbal Interpretation, and Questions for Functionality based on Agriculturists

Functionality	Weighted Mean	Verbal Interpretation
1. How well does the system cover all the essential agricultural tasks required for monitoring and maintaining the hydroponics greenhouse?	4.0	Satisfied
2. How accurately does the system monitor plant growth and water conditions using sensors?	3.9	Satisfied
3. How well does the system's functionality align with the specific needs of hydroponics lettuce farming?	3.8	Satisfied
4. How well is the systems' measurements of the solutions used (Ex. SNAP Solution, pH down and Up)?	4.3	Strongly Satisfied
Total Weighted Mean	4.0	Satisfied

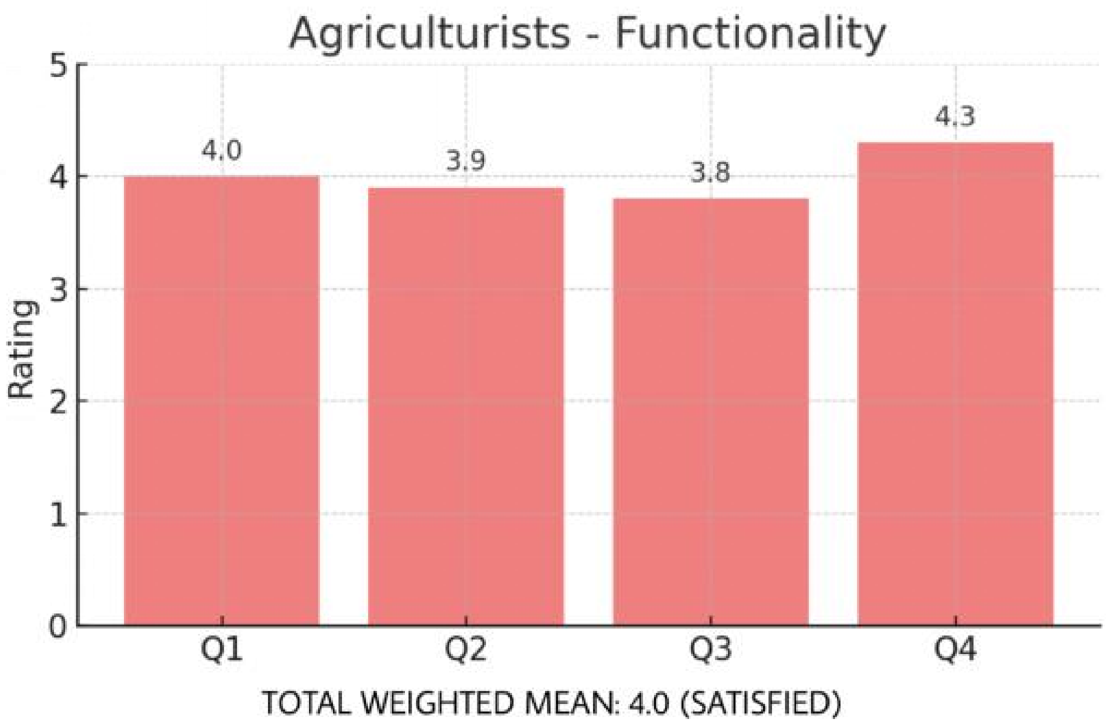

Figure 4.15 Agriculturists-Functionality

Figure 4.15 represents the agriculturists' perspective on the system's Functionality. The first question gained the second to the highest weighted mean of 3.0 and had a verbal interpretation of 'Satisfied'. Second question gained a weighted mean of 3.9 and had a verbal interpretation of 'Satisfied'. The third question gained the lowest weighted mean of 3.8, with a verbal interpretation of 'Satisfied'. Lastly, the fourth question gained the highest weighted mean of 4.3 and had a verbal interpretation of 'Strongly Satisfied'.

The overall weighted mean of 4.0 of all four questions and had a verbal interpretation of 'Satisfied'. The results support specific objectives number one, three, and four, which emphasize that the system manages to provide essential agricultural tasks required for monitoring and maintaining the hydroponics greenhouse accurately.

Table 4.9 Weighted Mean, Verbal Interpretation, and Questions for Compatibility based on Agriculturists

Compatibility	**Weighted Mean**	**Verbal Interpretation**
1. How well does the system integrate with other agricultural tools and equipment, which are temperature control systems and irrigation systems?	4.4	Strongly Satisfied
2. Is the system compliant with relevant agricultural standards and best practices for hydroponic farming?	3.9	Satisfied
3. How well is the system adaptable to different farming methods and practices?	3.8	Satisfied
4. How well does the system work with different types of hydroponics setups?	3.9	Satisfied
Total Weighted Mean	4.0	Satisfied

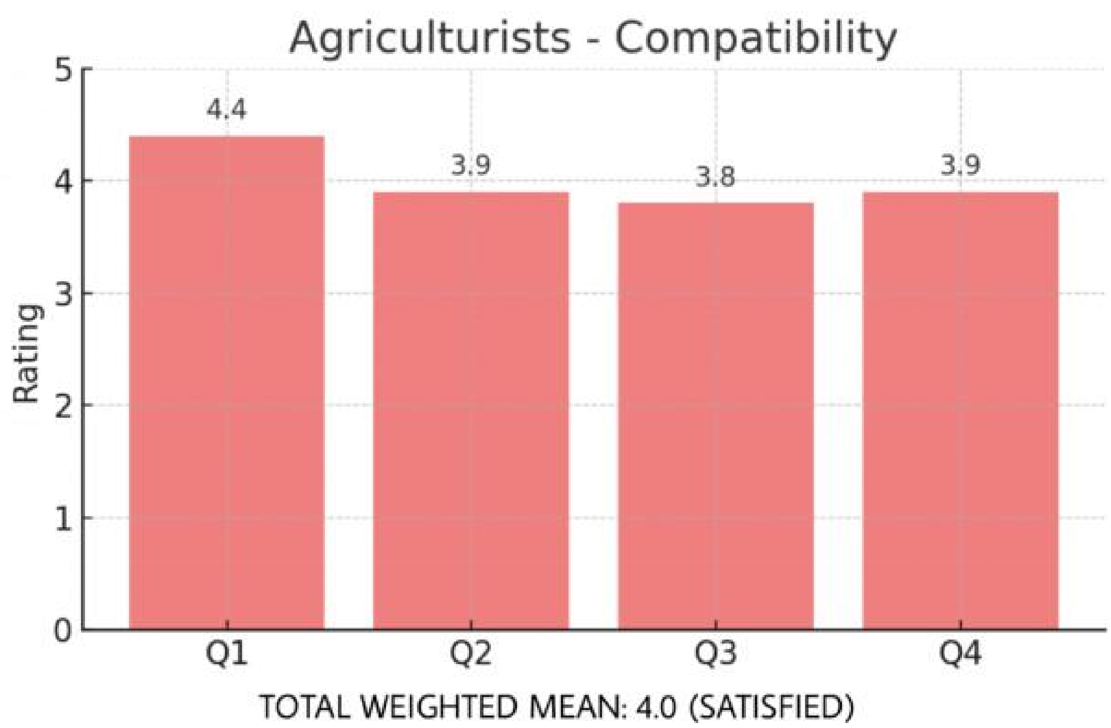

Figure 4.16 Agriculturists- Compatibility

Figure 4.16 represents the agriculturists' perspective on the system's compatibility. The first question received the leading weighted mean of 4.4 and had interpretation of 'Strongly Satisfied'. The second and fourth question gained the second to the highest weighted mean of 3.9 and had an interpretation of 'Satisfied'. And the third questions gained the lowest weighted mean of 3.8 and had an interpretation of 'Satisfied'.

The overall weighted mean of 4.0 of all four questions with an interpretation of 'Satisfied'. The result supports the specific objective number one and three, with a total weighted mean emphasizes that the system manages to integrate with other agricultural tools and equipment, which are temperature control systems and irrigation systems with compliance with relevant agricultural standards and best practices for hydroponic farming.

Table 4.10 Weighted Mean, Verbal Interpretation, and Questions for Usability based on Agriculturists

Usability	**Weighted Mean**	**Verbal Interpretation**
1. How user-friendly is the application for agriculturists in terms of monitoring and controlling the greenhouse environment	4.1	Satisfied
2. How well is the system features designed to support agriculturists with varying levels of technological expertise?	3.9	Satisfied
3. How easy is it to learn and use the automated system?	4.4	Strongly Satisfied
Total Weighted Mean	4.1	Satisfied

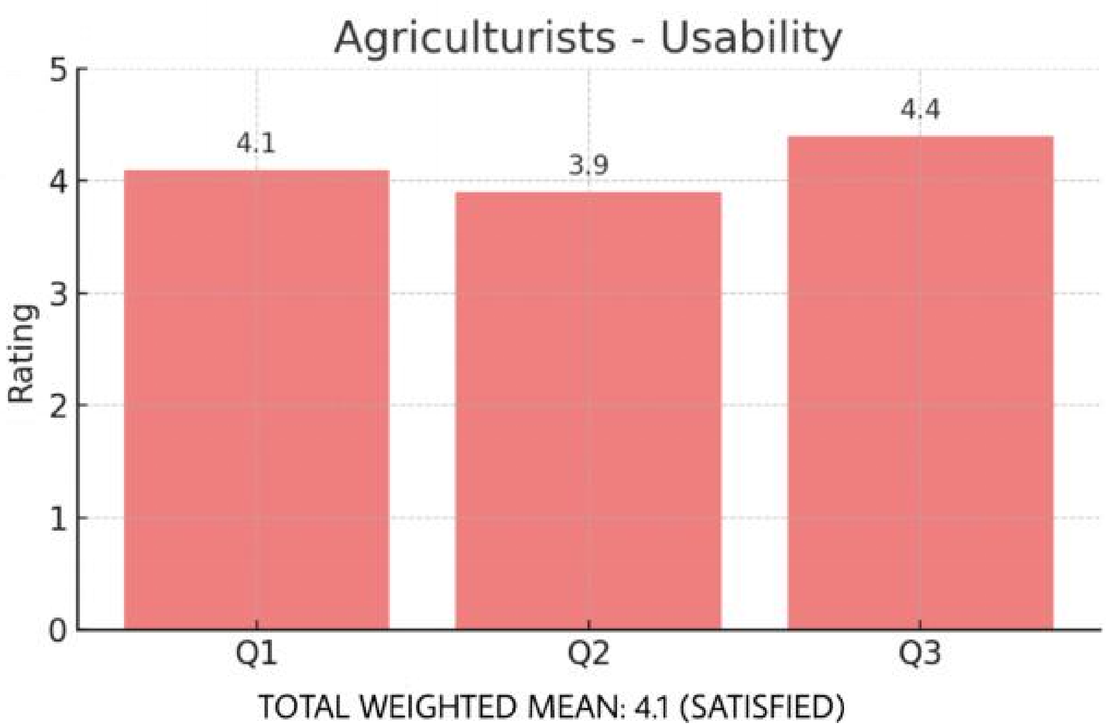

Figure 4.17 Agriculturists–Usability

Figure 4.17 represents the agriculturists' perspective on the system's Compatibility. The first question received second to the highest weighted mean of 4.1 and had aninterpretation of 'Satisfied'. The second question gained a weighted mean of 3.9 and had an interpretation of 'Satisfied'. Third question gained the leading weighted mean of 4.4 and had an interpretation of 'Strongly Satisfied'.

The overall weighted mean is 4.1 of all three questions and an interpretation of 'Satisfied'. The results support specific objectives one, three, and four, which emphasize that the system manages to have a user-friendly interface for navigating the application and website and providing accurate agricultural processes for lettuce cultivation.

Table 4.11 Weighted Mean, Verbal Interpretation, and Questions for Reliability based on Agriculturists

Reliability	Weighted Mean	Verbal Interpretation
1. How consistently does the system provide accurate and reliable data for plant health and growth monitoring?	4.1	Satisfied
2. How effectively does the system recover from disruptions or failures to ensure continuous operation?	4.0	Satisfied
3. How confident are you in the system's ability to give accurate data from the sensors?	4.0	Satisfied
Total Weighted Mean	4.0	Satisfied

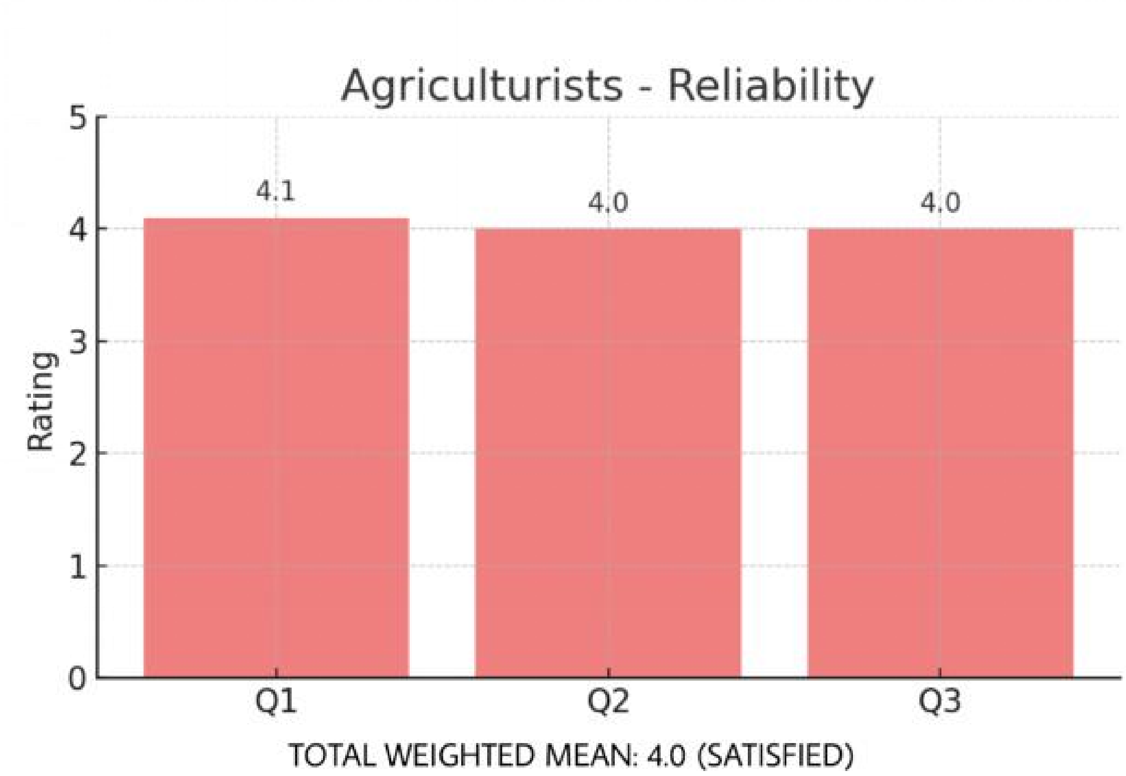

Figure 4.18 Agriculturists-Reliability

Figure 4.18 represents the agriculturists' perspective on the system's Compatibility. The first gained the leading weighted mean of 4.1 and had an interpretation of 'Satisfied'. The second and third question received the second to the highest weighted mean of 4.0 and had an interpretation of 'Satisfied'.

The overall weighted meanis 4.0 and had an interpretation of 'Satisfied'. The result supports specific objectives number three and four, which emphasize that the system manages to provide accurate and reliable data for plant health and growth monitoring and shows the ability to recover from possible errors.

Table 4.12 Weighted Mean, Verbal Interpretation, and Questions for Security based on Agriculturists

Security	**Weighted Mean**	**Verbal Interpretation**
1. How well does the system ensure the integrity and authenticity of the collected agricultural data?	4.1	Satisfied
2. How well is the control access to sensitive data and system functionalities?	3.7	Satisfied
3. How satisfied are you with the system's security features?	3.8	Satisfied
Total Weighted Mean	3.8	Satisfied

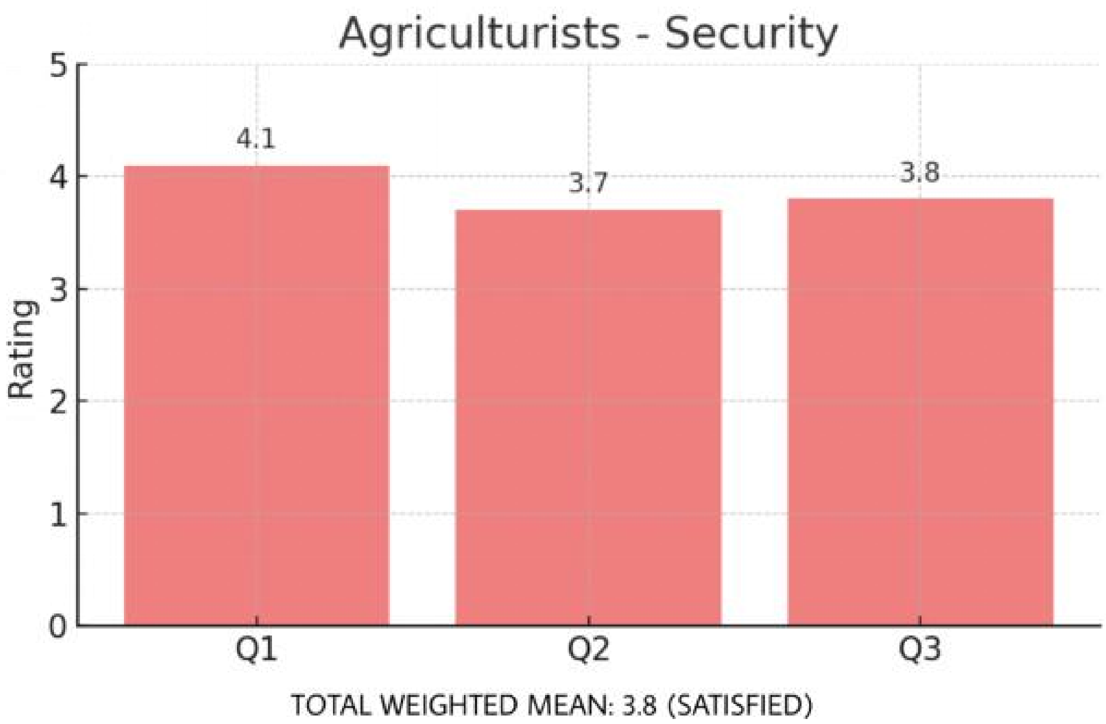

Figure 4.19 Agriculturists-Security

Figure 4.19 represents the agriculturists' perspective on the system's Security. The first question gained the leading weighted mean of 4.1 and had an interpretation of 'Satisfied'. The second question gained the second to the highest mean of 3.8 and had an interpretation of 'Satisfied'. The third question gained the lowest weighted mean of 3.8 and had an interpretation of 'Satisfied'.

The overall weighted mean is 3.8 of all three questions and had an interpretation of 'Satisfied'. The result of the total weighted mean emphasizes that the system manages to provide users with adequate measures to ensure security but it also shows it can be improved.

Table 4.13 Weighted Mean of the Proposed System

Based on the Sunnyville workers' Evaluation

Criteria	**Weighted Mean**	**Verbal Interpretation**
Functionality	4.0	Satisfied
Compatibility	3.8	Satisfied
Usability	4.1	Satisfied
Reliability	4.0	Satisfied
Security	3.9	Satisfied
Total Weighted Mean	3.96	Satisfied

Table 4.13 represents the workers' perspective on the system's overall criteria. Usability gained the leading weighted mean of 4.1 and had an interpretation of 'Satisfied', while Functionality and Reliability gained the second to the highest weighted mean of 4.0 and had an interpretation of 'Satisfied'. Security gained the lowest weighted mean of 3.9 and had an interpretation of 'Satisfied' and Compatibility gained a weighted mean of 3.8 and had an interpretation of 'Satisfied'..

Table 4.14 Weighted Mean of the Proposed System

Based on the Agriculturists' Evaluation

Criteria	**Weighted Mean**	**Verbal Interpretation**
Functionality	4.0	Satisfied
Compatibility	4.0	Satisfied
Usability	4.1	Satisfied
Reliability	4.0	Satisfied
Security	3.8	Satisfied
Total Weighted Mean	3.9	Satisfied

Table 4.14 represents the agriculturists' perspective on the system's overall criteria. Usability gained the leading weighted mean of 4.1 and had an interpretation of 'Satisfied,' while the second to the highest is Functionality, Compatibility, and Reliability with a weighted mean of 4.0 and had an interpretation of 'Satisfied'. Security gained the lowest weighted mean of 3.8 and had an interpretation of 'Satisfied'. The overall weighted mean of all the five criteria is 3.9 and had an interpretation of 'Satisfied'. Therefore, the system manages to have a satisfactory result in the agriculturists' field of expertise and meets the standard of the following criteria.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Topics in previous chapter are briefly discussed in this chapter that led to the completion of developing a hydroponics greenhouse prototype modeled after the Sunnyville Community Model Farm for lettuce cultivation, supported by an Android application real-time control, monitoring, and Web Application for Farm Managers summarized farm data. After conducting research, the proponents have came up with the following Summary of Findings, Conclusion, Recommendation of the study.

5.1 Summary of Findings

The study successfully achieved several key objectives, resulting in the development of a Hydroponics Greenhouse Prototype tailored for lettuce cultivation. The prototype was designed with sustainable agricultural principles in mind, incorporating a rainwater drainage system and solar panels to support operations. Evaluation of the prototype by workers and agriculturists resulted in an average satisfaction rating of 4.0, confirming its effectiveness in providing a functional structure for lettuce cultivation. In addition, the system incorporated two distinct user levels—the Farm Manager and the Farmers—each with specific interfaces and functionalities. The AGREEMO application allowed the Farm Manager to monitor and manage reports, while Farmers could adjust and track water conditions, temperature, and humidity. The user-level design was validated by usability assessments, with a satisfaction rating of 4.1, confirming its successful implementation.

The study developed an Android Application to enhance farm management. AGREEMO monitored critical factors such as water levels, pH, and nutrient solutions, as well as environmental conditions like temperature and humidity within the greenhouse. AGREEMO used sensors and automated controls to maintain optimal growing conditions, with functionality assessments showing high user satisfaction (average rating of 4.0). The application allowed real-time notifications and precise adjustments, reducing the need for manual checks. Furthermore, a website application was created to summarize and manage reports, harvest data, and user accounts, which was also rated highly for its functionality. Overall, the study demonstrated the effectiveness of the integrated systems in managing and optimizing the hydroponic lettuce cultivation process. Overall, effectiveness of integrate systems on managing and optimizing an hydroponic lettuce cultivation process are demonstrated in the study.

5.2 Conclusion

This chapter presents the conclusions drawn from development, implementation, and evaluation of AGREEMO system: an Android-based application integrated with a solar-powered hydroponics greenhouse for lettuce cultivation. The conclusions are organized according to the project’s five special objectives, reflecting how each was addressed based on technical results, user feedback, and system performance. The findings highlight the effectivenes of integration of automation, IoT, and sustainable enegry at urban farming environments.

1. The prototype was successfully built, incorporating ESP32 microcontrollers, pH and TDS sensors, temperature and humidity sensors, ultrasonic level detectors, and solar-powered automation. The system demonstrated reliable performance in maintaining optimal environmental conditions through automatic triggering of misting and exhaust systems, as well as real-time alerting for low water levels. Feasibility of a self-sustaining smart greenhouse is validated through integration of rainwater collection and renewable energy sources.

2. The greenhouse was effectively customized for lettuce growth, maintaining stable pH and TDS levels within the optimal range. Farmers reported improved plant health and fewer manual interventions due to automated monitoring. The rainwater collection system and solar energy source contributed to the prototype's sustainability, while real-time environmental control ensured consistent plant development.

3. The Android application provided a responsive and user-friendly interface for monitoring sensor data and manually controlling greenhouse operations. Farmers successfully used the app to track pH, TDS, water levels, and greenhouse temperature/humidity. The app also integrated AI-

based image recognition using YOLOv8 to identify lettuce growth stages, achieving a 78% accuracy rate. Notifications helped farmers take timely action when conditions required attention.

4. The web application functioned effectively as a centralized management tool. It consolidated farmer reports, tracked crop performance, managed inventory and user accounts, and visualized greenhouse data. Automated logs and real-time updates enhanced decision-making and operational oversight for the farm manager.

5. The system scored highly across the ISO 25010 quality attributes, with weighted means ranging from 3.9 to 4.1, indicating high user satisfaction. The application proved functional, usable, and reliable, although some feedback indicated the need to improve compatibility with older Android versions and introduce offline feature.

The AGREEMO system successfully achieved its goal of modernizing hydroponic greenhouse operations through automation, IoT integration, and dual-platform accessibility. It reduced manual labor, improved environmental control, and promoted sustainability through solar and rainwater usage. With minor enhancements, AGREEMO can be adopted more widely as a model for smart, scalable, and sustainable agriculture in community-based urban farms.

5.3 Recommendation

To enhance the effectiveness of the hydroponic greenhouse system, future researchers are encouraged to explore various recommendations. The current system is designed exclusively for lettuce; consider improving its capabilities to accommodate additional leafy greens that can grow in hydroponic greenhouse, like spinach, broccoli, cabbage, Chinese cabbage, and more. The system would be more adaptable and suitable for a greater variety of urban farming requirements. Include pesticide and pest control features to prevent any possible diseases, such as pest detection alerts or automated spraying systems. It would assist farmers in maintaining better crops and more successfully reducing pest-related problems. Include predictive maintenance alerts to let farmers know when parts like filters and pumps need to be replaced or serviced. Expand solar power connections to the greenhouse and Include features that allow farmers and farmers manager to monitor how much power the solar panel created and the power level of the battery used.

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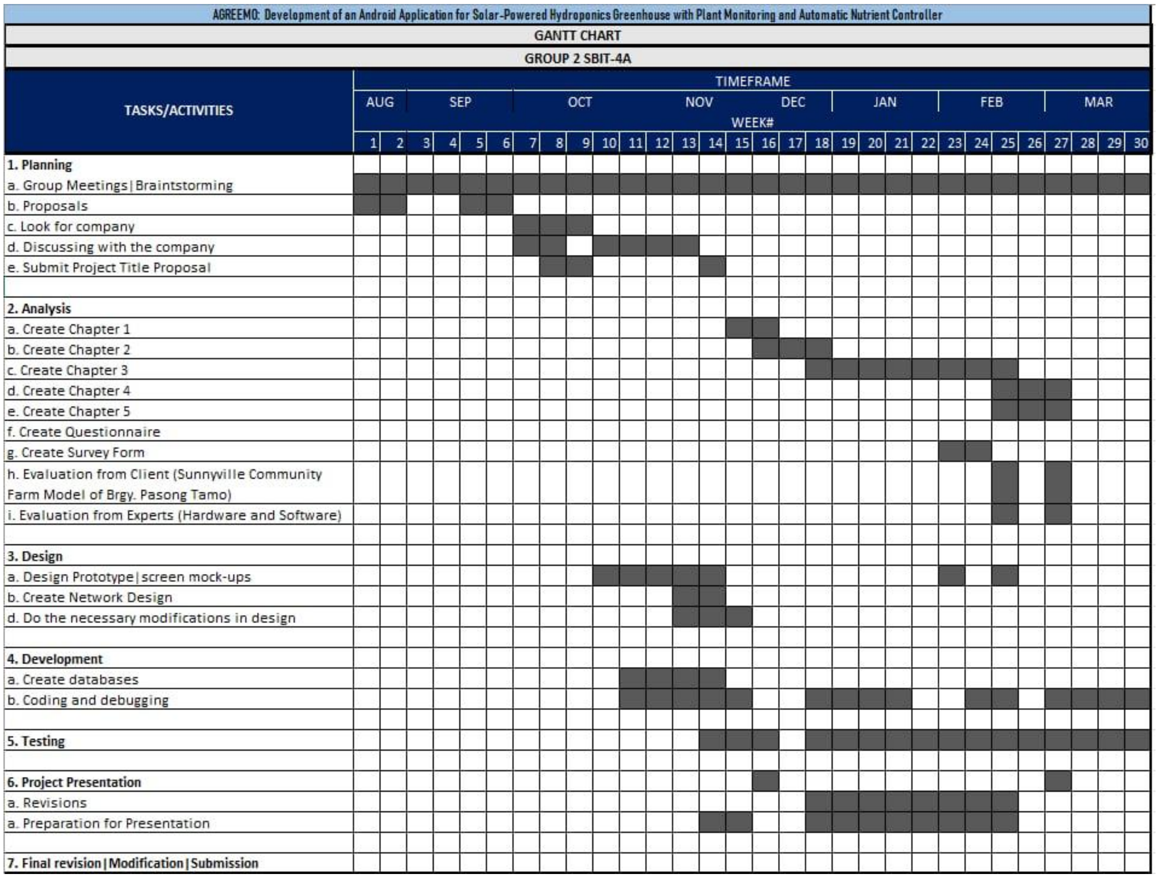
APPENDICES

APPENDIX A

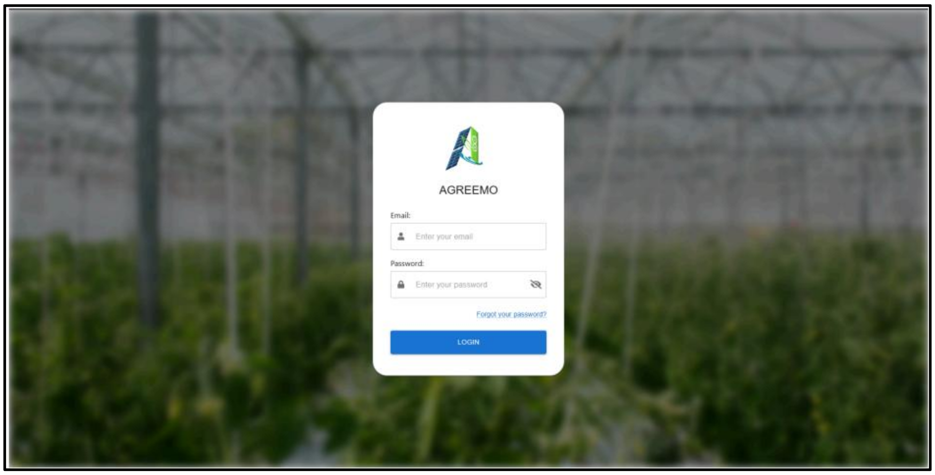
Gantt Chart

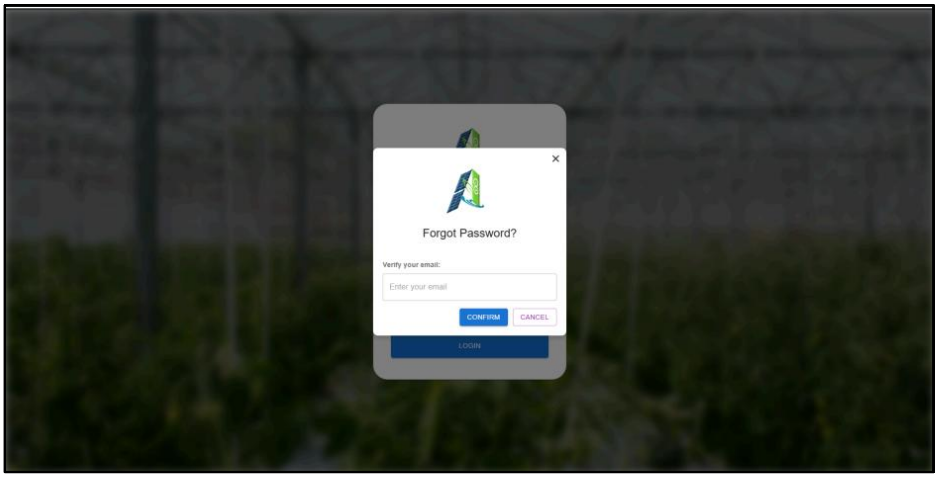


APPENDIX B

System Design Models

Web Design Model



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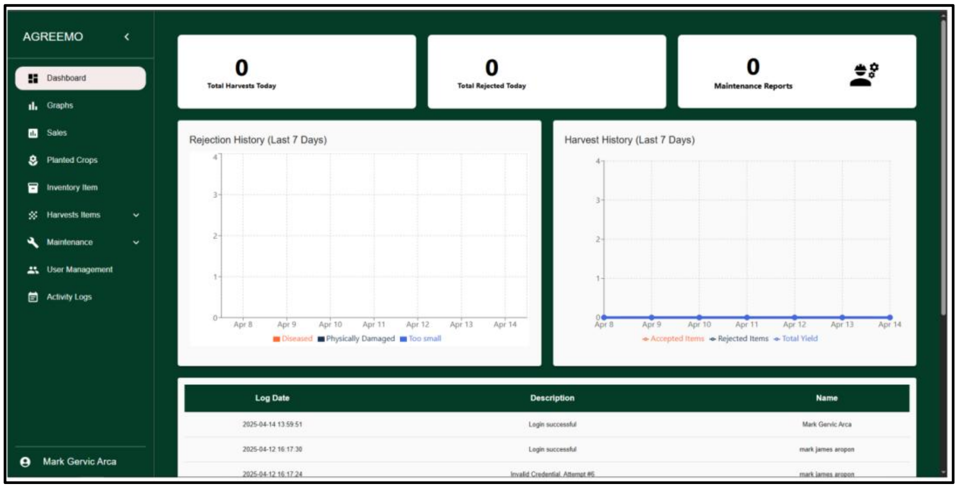
AGREEMO
New Password
Confirm Password
Submit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Planted Crops
Inventory Item
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Mark Gervic Arca
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Total Harvests Today
0
Total Rejected Today
0
Maintenance Reports
Rejection History (Last 7 Days)
Diseased
Physically Damaged
Too small
Harvest History (Last 7 Days)
Accepted Items
Rejected Items
Total Yield
Log Date
Description
Name
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Login successful
Mark Gervic Arca
2025-04-12 16:17:30
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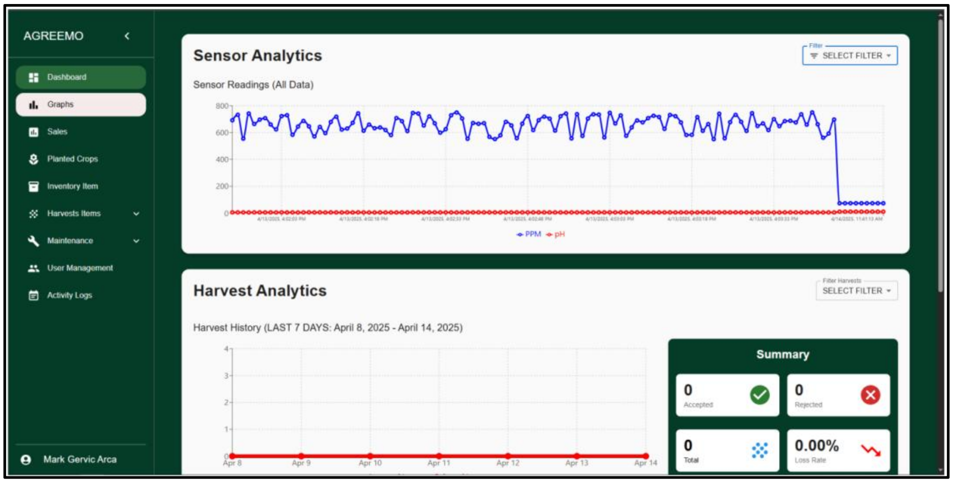
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Mark Gervic Arca
Sensor Analytics
SELECT FILTER
Sensor Readings (All Data)
PPM
pH
Harvest Analytics
SELECT FILTER
Harvest History (LAST 7 DAYS: April 8, 2025 - April 14, 2025)
Summary
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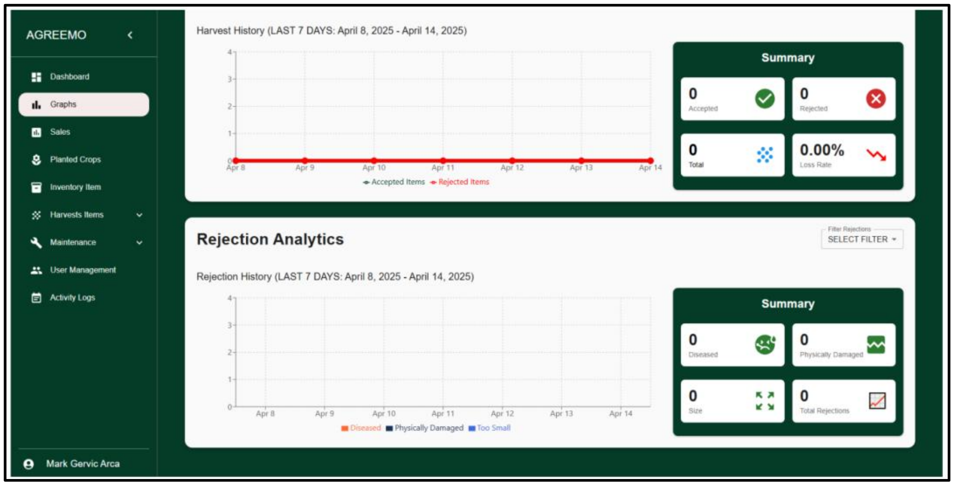
Accepted
0
Rejected
0
Total
0.00%
Loss Rate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Mark Gervic Arca
Harvest History (LAST 7 DAYS: April 8, 2025 - April 14, 2025)
Accepted Items
Rejected Items
Summary
0 Accepted
0 Rejected
0 Total
0.00% Loss Rate
Rejection Analytics
SELECT FILTER
Rejection History (LAST 7 DAYS: April 8, 2025 - April 14, 2025)
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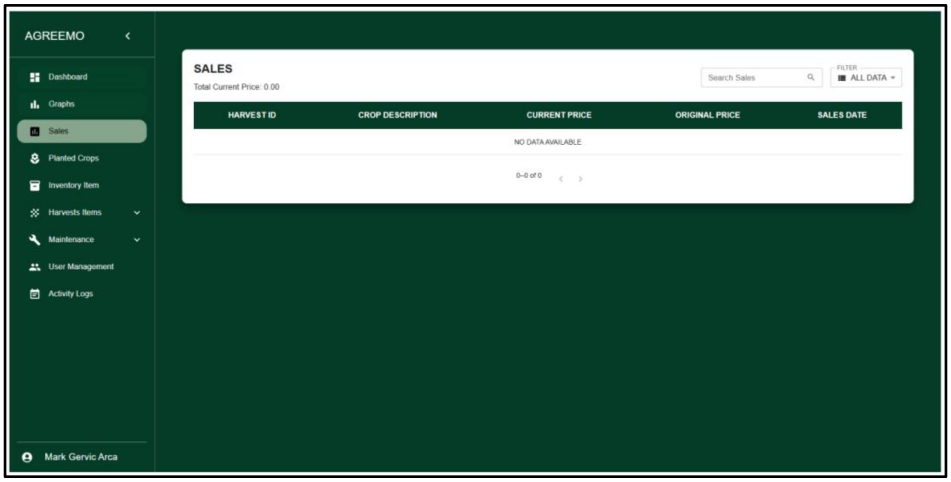
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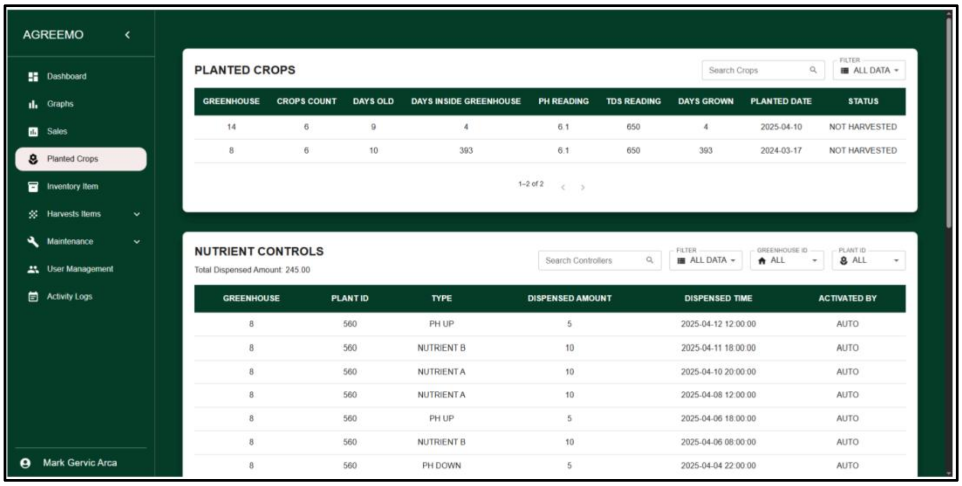
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PLANTED CROPS
Search Crops
ALL DATA
GREENHOUSE CROPS COUNT DAYS OLD DAYS INSIDE GREENHOUSE PH READING TDS READING DAYS GROWN PLANTED DATE STATUS
14 6 9 4 6.1 650 4 2025-04-10 NOT HARVESTED
8 6 10 393 6.1 650 393 2024-03-17 NOT HARVESTED
1–2 of 2
NUTRIENT CONTROLS
Total Dispensed Amount: 245.00
Search Controllers
ALL DATA
ALL
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GREENHOUSE PLANT ID TYPE DISPENSED AMOUNT DISPENSED TIME ACTIVATED BY
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8 560 NUTRIENT B 10 2025-04-11 18:00:00 AUTO
8 560 NUTRIENT A 10 2025-04-10 20:00:00 AUTO
8 560 NUTRIENT A 10 2025-04-08 12:00:00 AUTO
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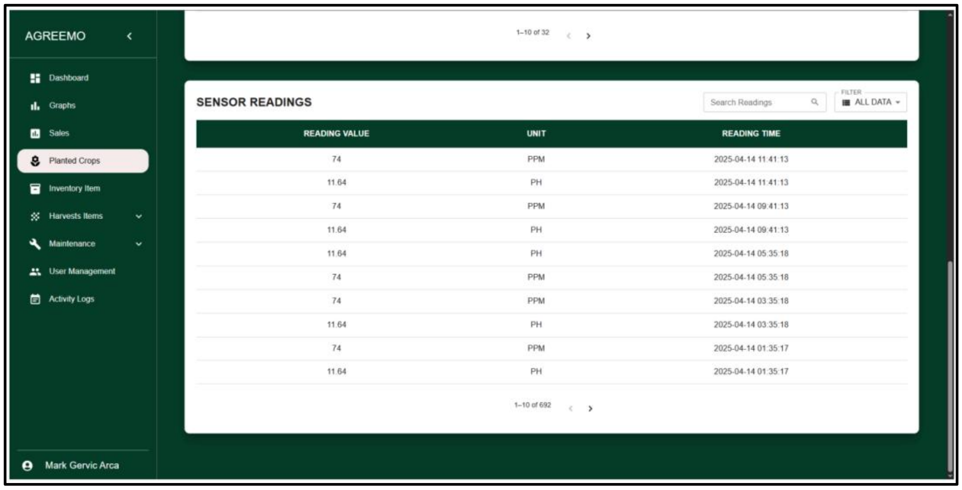
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1–10 of 32
SENSOR READINGS
Search Readings
FILTER
ALL DATA
READING VALUE | UNIT | READING TIME
74 | PPM | 2025-04-14 11:41:13
11.64 | PH | 2025-04-14 11:41:13
74 | PPM | 2025-04-14 09:41:13
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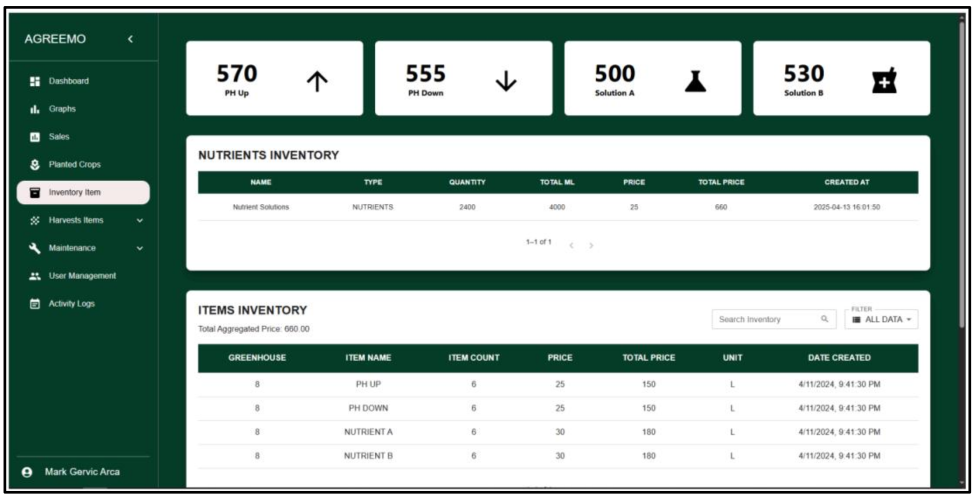
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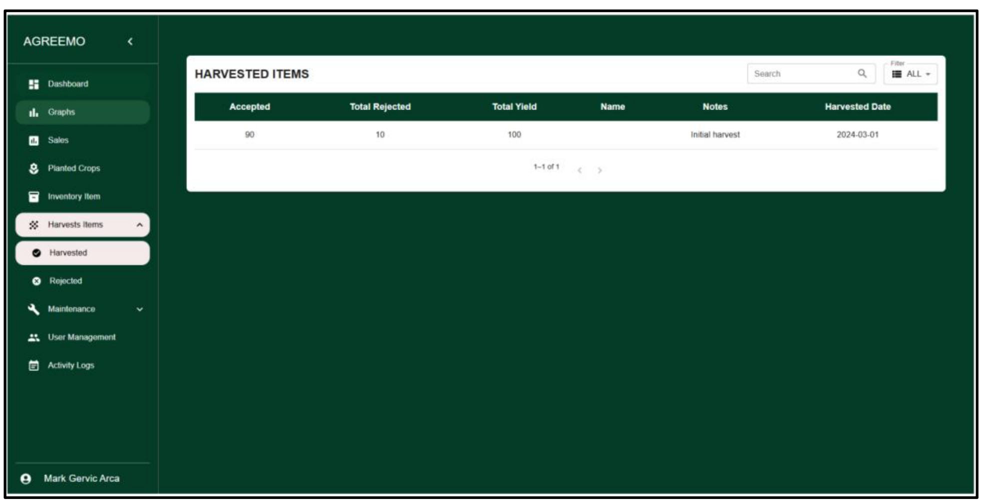
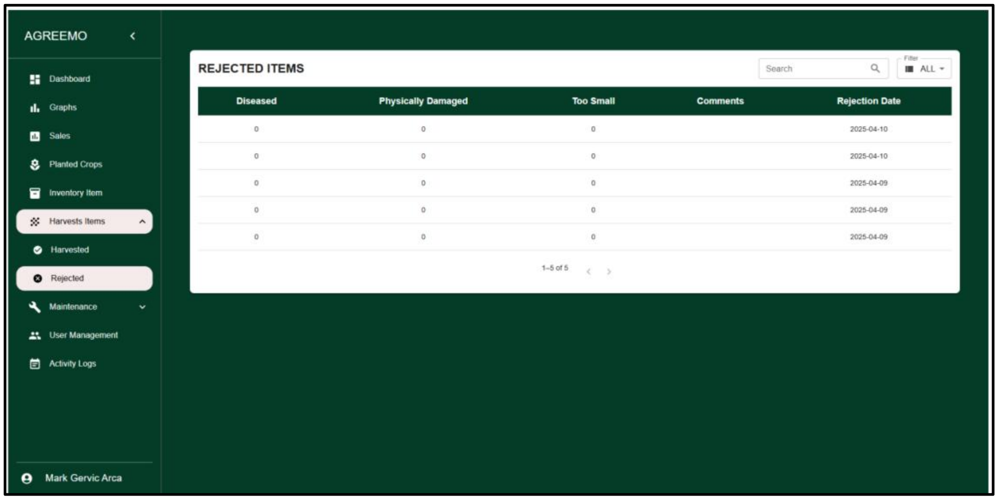
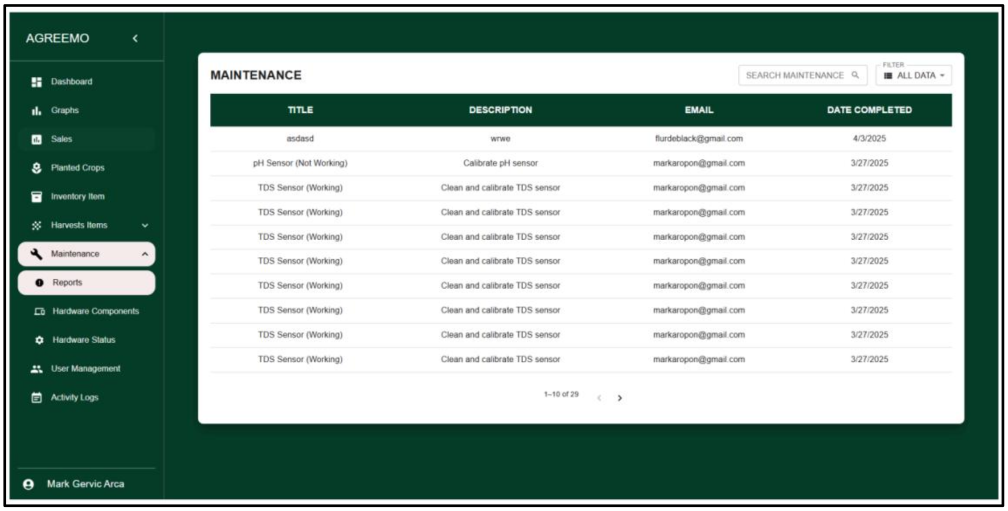
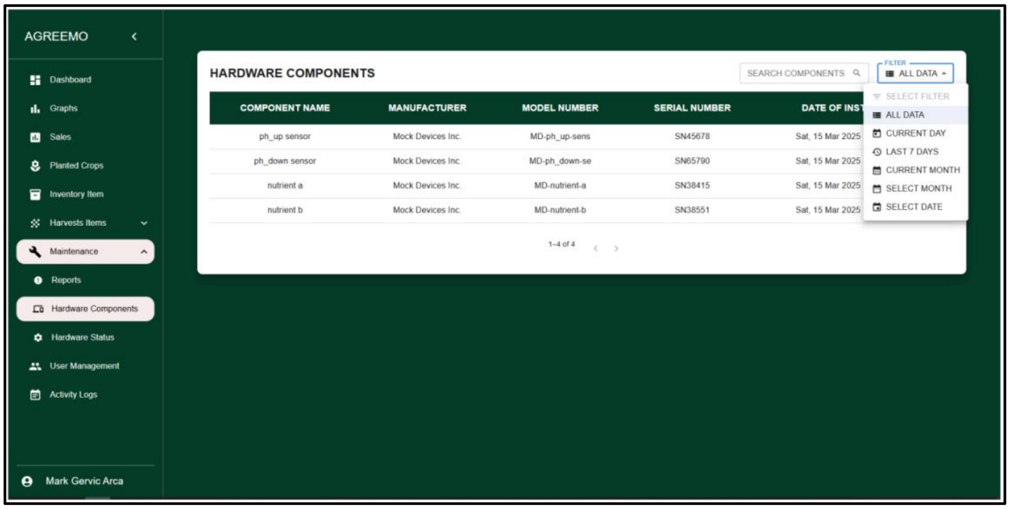
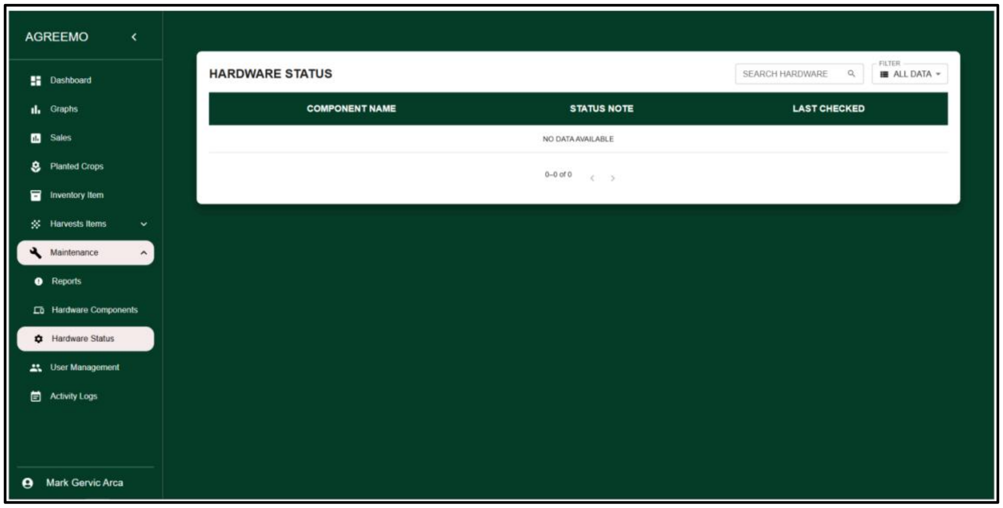
500 Solution A
530 Solution B
NUTRIENTS INVENTORY
NAME | TYPE | QUANTITY | TOTAL ML | PRICE | TOTAL PRICE | CREATED AT
Nutrient Solutions | NUTRIENTS | 2400 | 4000 | 25 | 660 | 2025-04-13 16:01:50
1–1 of 1
ITEMS INVENTORY
Total Aggregated Price: 660.00
Search Inventory
FILTER
ALL DATA
GREENHOUSE | ITEM NAME | ITEM COUNT | PRICE | TOTAL PRICE | UNIT | DATE CREATED
8 | PH UP | 6 | 25 | 150 | L | 4/11/2024, 9:41:30 PM
8 | PH DOWN | 6 | 25 | 150 | L | 4/11/2024, 9:41:30 PM
8 | NUTRIENT A | 6 | 30 | 180 | L | 4/11/2024, 9:41:30 PM
8 | NUTRIENT B | 6 | 30 | 180 | L | 4/11/2024, 9:41:30 PM

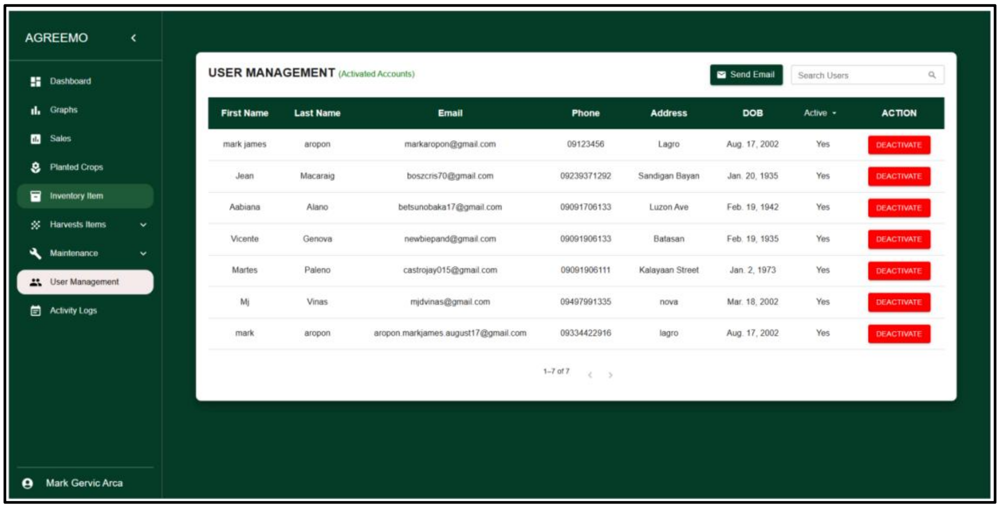

AGREEMO
Dashboard
Graphs
Sales
Planted Crops
Inventory Item
Harvests Items
Harvested
Rejected
Maintenance
User Management
Activity Logs
Mark Gervic Arca
HARVESTED ITEMS
Search
Filter
ALL
Accepted | Total Rejected | Total Yield | Name | Notes | Harvested Date
90 | 10 | 100 | | Initial harvest | 2024-03-01
1–1 of 1

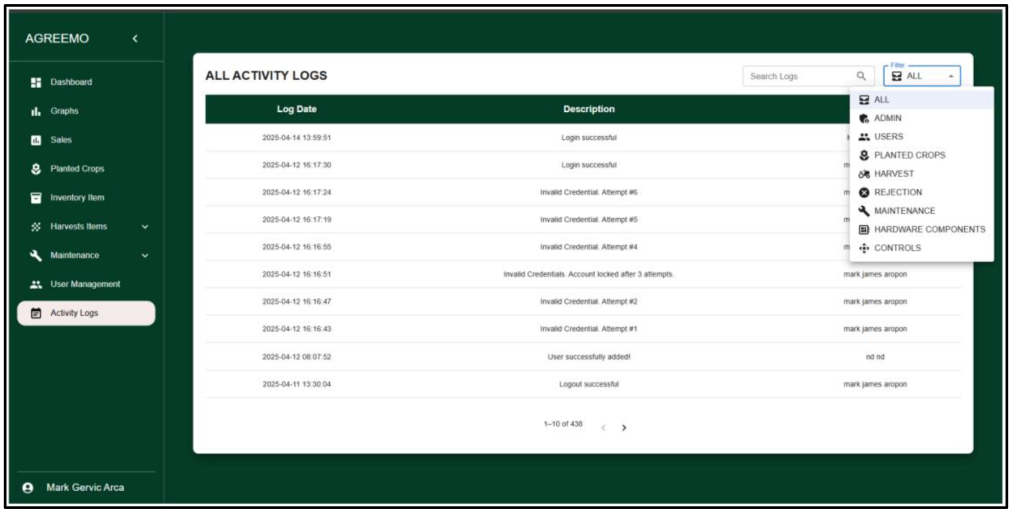

AGREEMO
Dashboard
Graphs
Sales
Planted Crops
Inventory Item
Harvests Items
Harvested
Rejected
Maintenance
User Management
Activity Logs
Mark Gervic Arca
REJECTED ITEMS
Search
Filter
ALL
Diseased
Physically Damaged
Too Small
Comments
Rejection Date
0 0 0 2025-04-10
0 0 0 2025-04-10
0 0 0 2025-04-09
0 0 0 2025-04-09
0 0 0 2025-04-09
1–5 of 5


AGREEMO
Dashboard
Graphs
Sales
Planted Crops
Inventory Item
Harvests Items
Maintenance
Reports
Hardware Components
Hardware Status
User Management
Activity Logs
Mark Gervic Arca
MAINTENANCE
SEARCH MAINTENANCE
FILTER
ALL DATA
TITLE
DESCRIPTION
EMAIL
DATE COMPLETED
asdasd wrwe flurdeblack@gmail.com 4/3/2025
pH Sensor (Not Working) Calibrate pH sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
TDS Sensor (Working) Clean and calibrate TDS sensor markaropon@gmail.com 3/27/2025
1–10 of 29

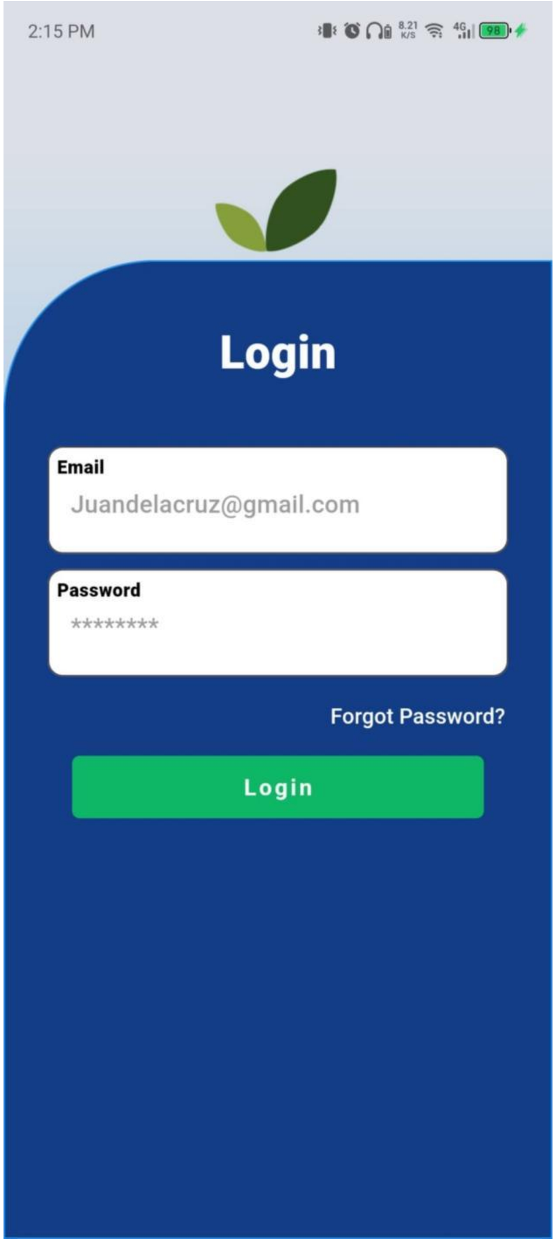

AGREEMO
Dashboard
Graphs
Sales
Planted Crops
Inventory Item
Harvests Items
Maintenance
Reports
Hardware Components
Hardware Status
User Management
Activity Logs
Mark Gervic Arca
HARDWARE COMPONENTS
SEARCH COMPONENTS
FILTER
ALL DATA
COMPONENT NAME
MANUFACTURER
MODEL NUMBER
SERIAL NUMBER
DATE OF INST
ph_up sensor Mock Devices Inc. MD-ph_up-sens SN45678 Sat, 15 Mar 2025
ph_down sensor Mock Devices Inc. MD-ph_down-se SN65790 Sat, 15 Mar 2025
nutrient a Mock Devices Inc. MD-nutrient-a SN38415 Sat, 15 Mar 2025
nutrient b Mock Devices Inc. MD-nutrient-b SN38551 Sat, 15 Mar 2025
SELECT FILTER
ALL DATA
CURRENT DAY
LAST 7 DAYS
CURRENT MONTH
SELECT MONTH
SELECT DATE
1–4 of 4

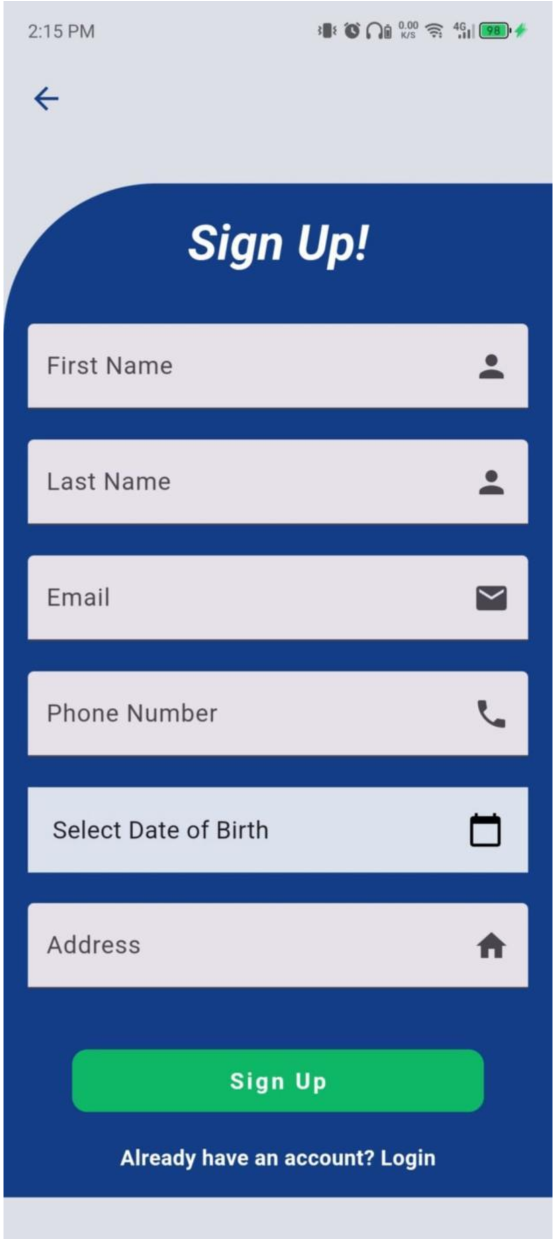

AGREEMO
Dashboard
Graphs
Sales
Planted Crops
Inventory Item
Harvests Items
Maintenance
Reports
Hardware Components
Hardware Status
User Management
Activity Logs
Mark Gervic Arca
HARDWARE STATUS
SEARCH HARDWARE
FILTER
ALL DATA
COMPONENT NAME
STATUS NOTE
LAST CHECKED
NO DATA AVAILABLE
0–0 of 0

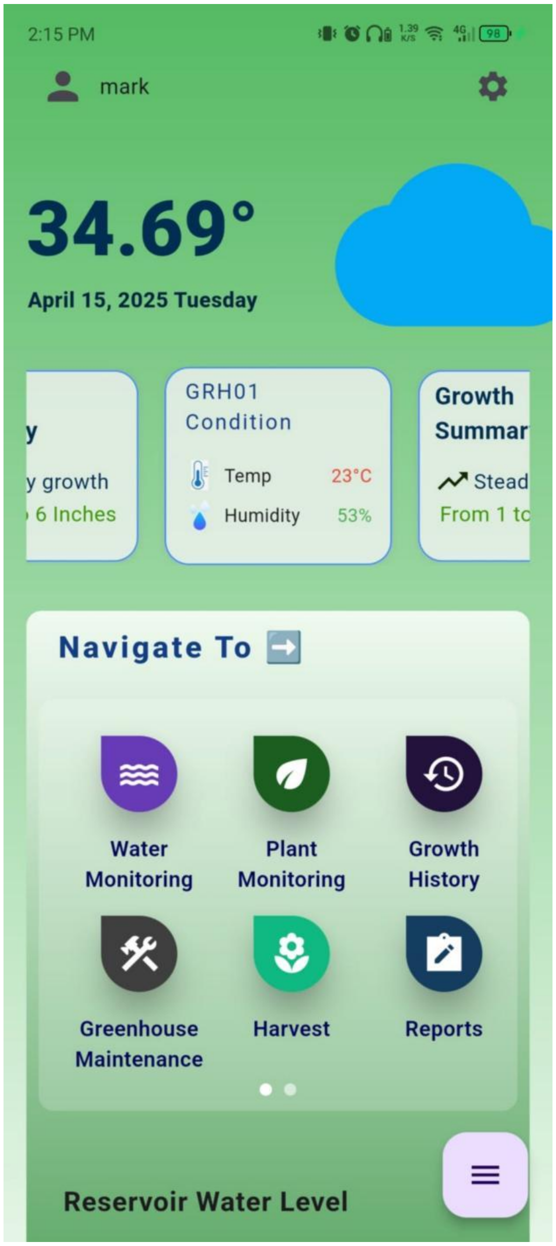

AGREEMO
Dashboard
Graphs
Sales
Planted Crops
Inventory Item
Harvests Items
Maintenance
User Management
Activity Logs
Mark Gervic Arca
USER MANAGEMENT (Activated Accounts)
Send Email
Search Users
First Name
Last Name
Email
Phone
Address
DOB
Active
ACTION
mark james aropon markaropon@gmail.com 09123456 Lagro Aug. 17, 2002 Yes DEACTIVATE
Jean Macaraig boszcris70@gmail.com 09239371292 Sandigan Bayan Jan. 20, 1935 Yes DEACTIVATE
Aabiana Alano betsunobaka17@gmail.com 09091706133 Luzon Ave Feb. 19, 1942 Yes DEACTIVATE
Vicente Genova newbiepand@gmail.com 09091906133 Batasan Feb. 19, 1935 Yes DEACTIVATE
Martes Paleno castrojay015@gmail.com 09091906111 Kalayaan Street Jan. 2, 1973 Yes DEACTIVATE
Mj Vinas mjdvinas@gmail.com 09497991335 nova Mar. 18, 2002 Yes DEACTIVATE
mark aropon aropon.markjames.august17@gmail.com 09334422916 lagro Aug. 17, 2002 Yes DEACTIVATE
1–7 of 7


AGREEMO
Dashboard
Graphs
Sales
Planted Crops
Inventory Item
Harvests Items
Maintenance
User Management
Activity Logs
Mark Gervic Arca
ALL ACTIVITY LOGS
Search Logs
Filter
ALL
Log Date
Description
ALL
ADMIN
USERS
PLANTED CROPS
HARVEST
REJECTION
MAINTENANCE
HARDWARE COMPONENTS
CONTROLS
2025-04-14 13:59:51 Login successful
2025-04-12 16:17:30 Login successful
2025-04-12 16:17:24 Invalid Credential. Attempt #6
2025-04-12 16:17:19 Invalid Credential. Attempt #5
2025-04-12 16:16:55 Invalid Credential. Attempt #4
2025-04-12 16:16:51 Invalid Credentials. Account locked after 3 attempts. mark james aropon
2025-04-12 16:16:47 Invalid Credential. Attempt #2 mark james aropon
2025-04-12 16:16:43 Invalid Credential. Attempt #1 mark james aropon
2025-04-12 08:07:52 User successfully added! nd nd
2025-04-11 13:30:04 Logout successful mark james aropon
1–10 of 438

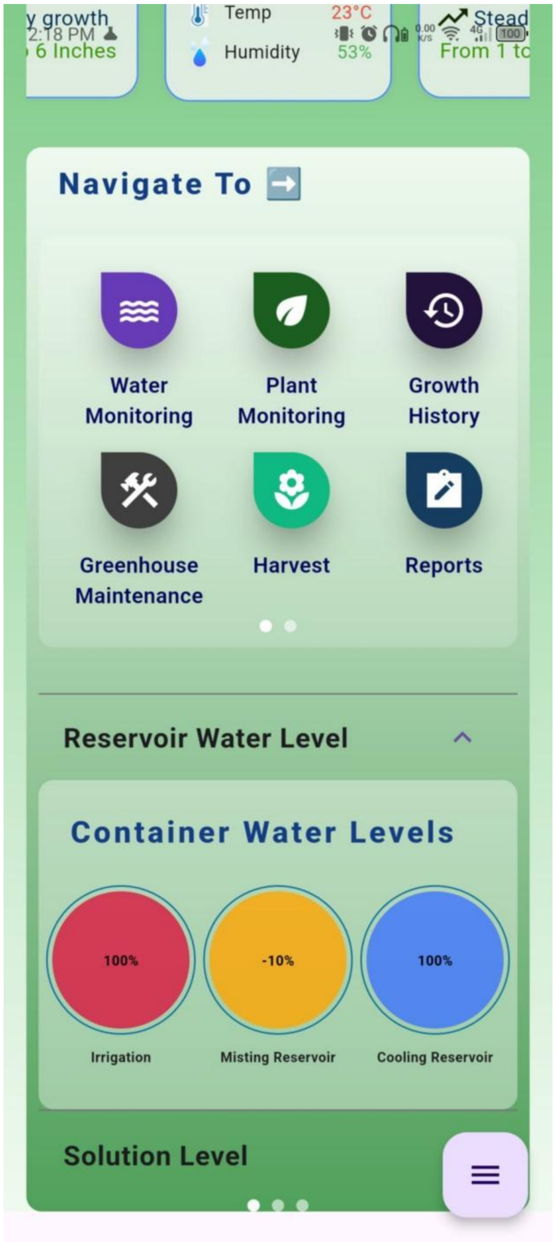
Mobile Design Model

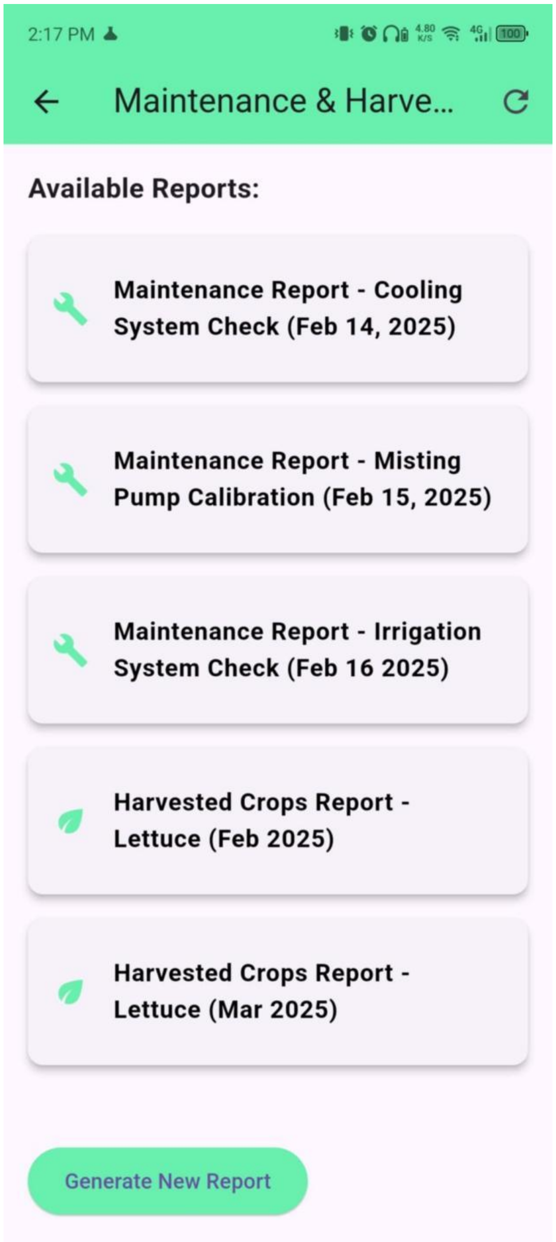

2:15 PM
Login
Email
Juandelacruz@gmail.com
Password
****
Forgot Password?
Login

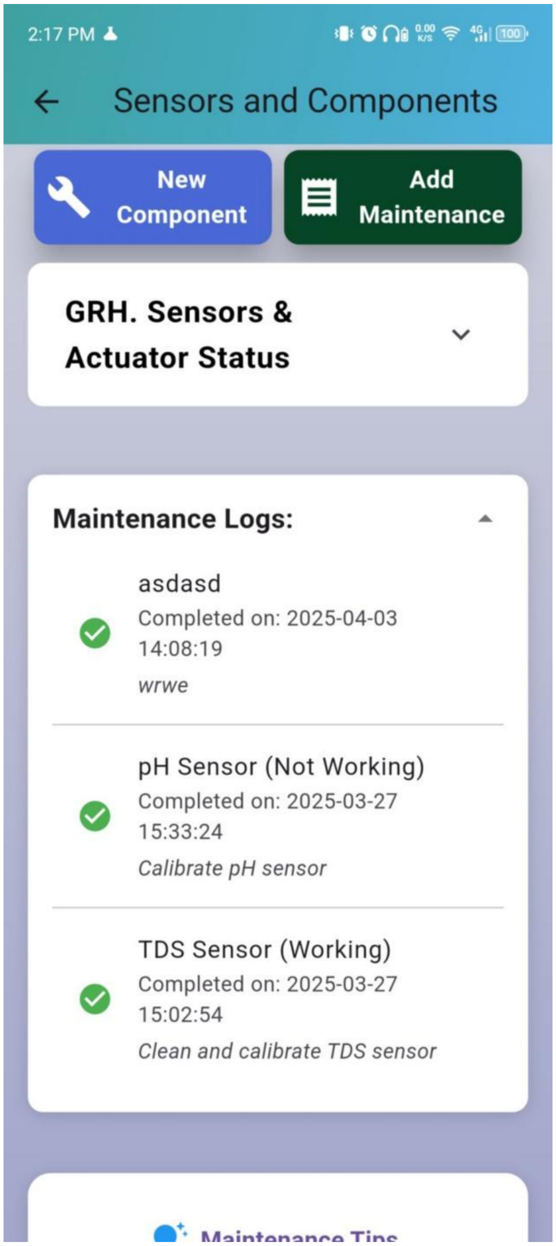

2:15 PM
Sign Up!
First Name
Last Name
Email
Phone Number
Select Date of Birth
Address
Sign Up
Already have an account? Login

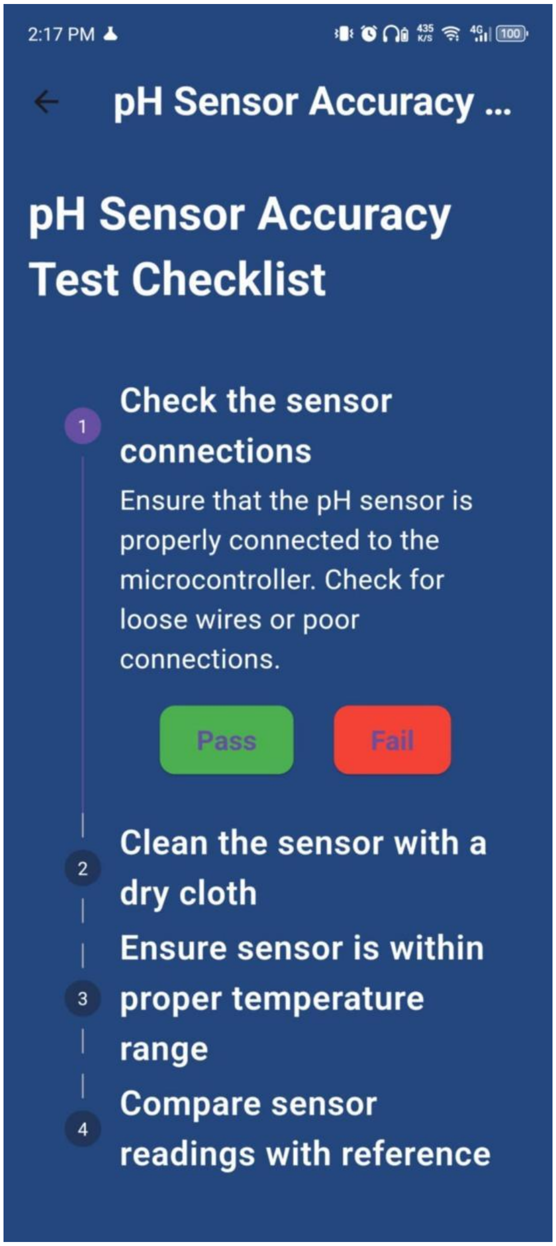

2:15 PM
mark
34.69°
April 15, 2025 Tuesday
GRH01
Condition
Temp 23°C
Humidity 53%
Growth
Summar
Stead
From 1 to
y growth
6 Inches
Navigate To
Water Monitoring
Plant Monitoring
Growth History
Greenhouse Maintenance
Harvest
Reports
Reservoir Water Level

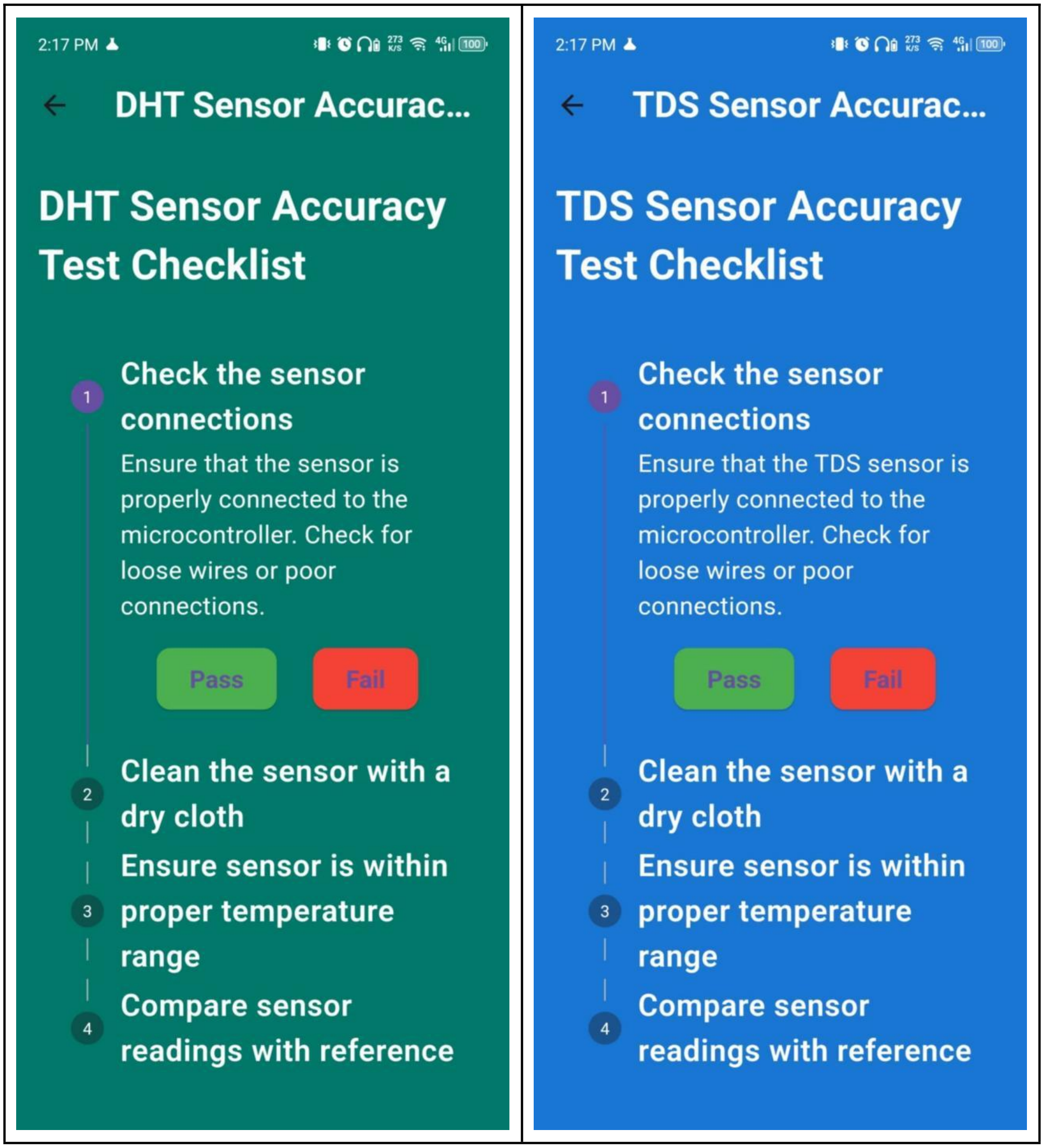

2:18 PM
Water Monitoring
Plant Monitoring
Growth History
Greenhouse Maintenance
Harvest
Reports
Reservoir Water Level
Solution Level
Solution Levels
100%
Solution A
100%
Solution B
100%
pH Solution +
100%
pH Solution -

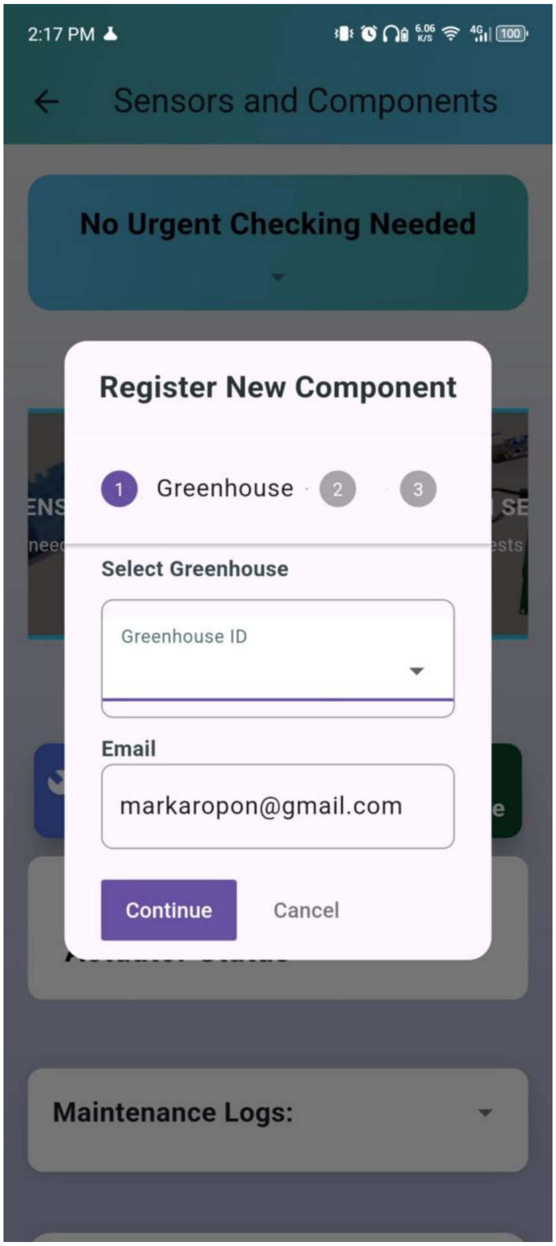

y growth
6 Inches
Temp
23°C
Humidity
53%
Stead
From 1 to
Navigate To
Water Monitoring
Plant Monitoring
Growth History
Greenhouse Maintenance
Harvest
Reports
Reservoir Water Level
Container Water Levels
100%
-10%
100%
Irrigation
Misting Reservoir
Cooling Reservoir
Solution Level

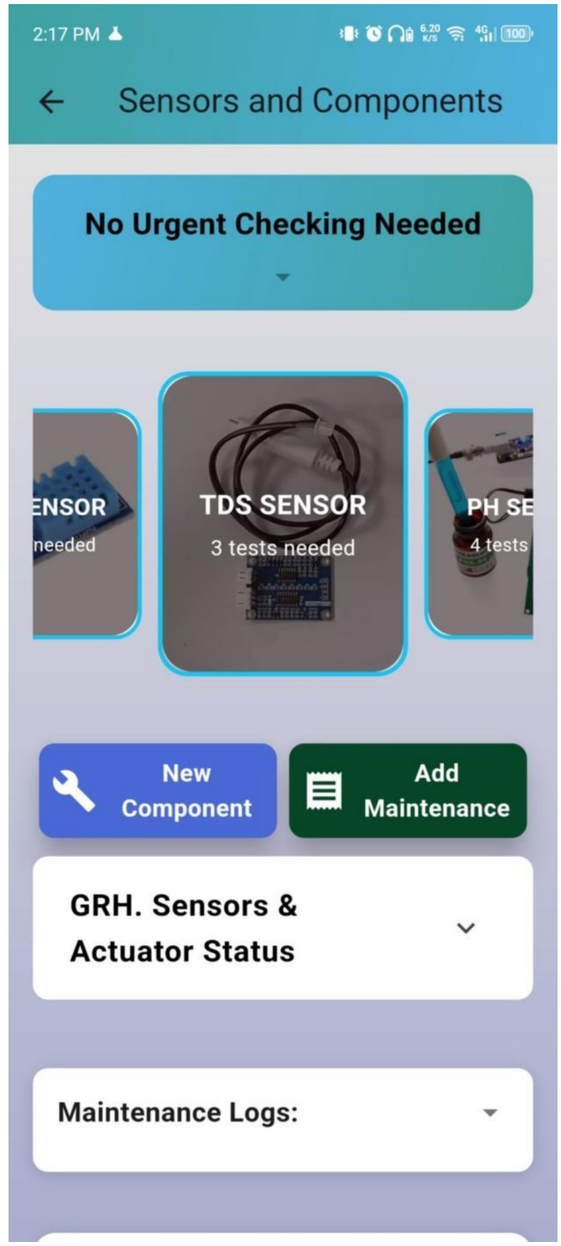

2:17 PM
Maintenance & Harve...
Available Reports:
Maintenance Report - Cooling System Check (Feb 14, 2025)
Maintenance Report - Misting Pump Calibration (Feb 15, 2025)
Maintenance Report - Irrigation System Check (Feb 16 2025)
Harvested Crops Report - Lettuce (Feb 2025)
Harvested Crops Report - Lettuce (Mar 2025)
Generate New Report

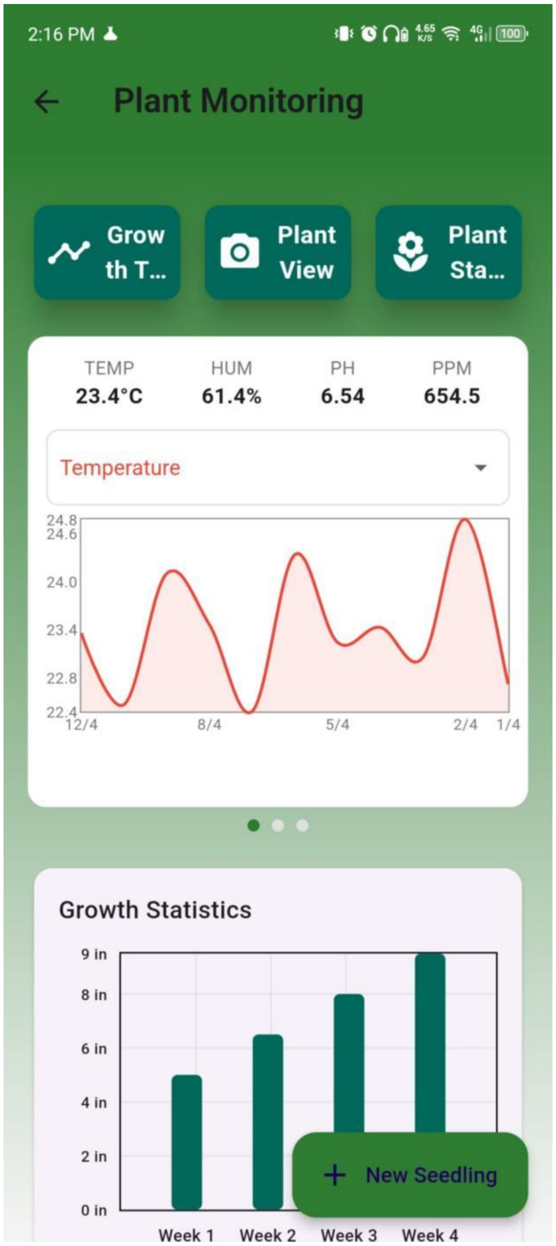

2:17 PM
Sensors and Components
New Component
Add Maintenance
GRH. Sensors & Actuator Status
Maintenance Logs:
asdasd
Completed on: 2025-04-03 14:08:19
wrwe
pH Sensor (Not Working)
Completed on: 2025-03-27 15:33:24
Calibrate pH sensor
TDS Sensor (Working)
Completed on: 2025-03-27 15:02:54
Clean and calibrate TDS sensor

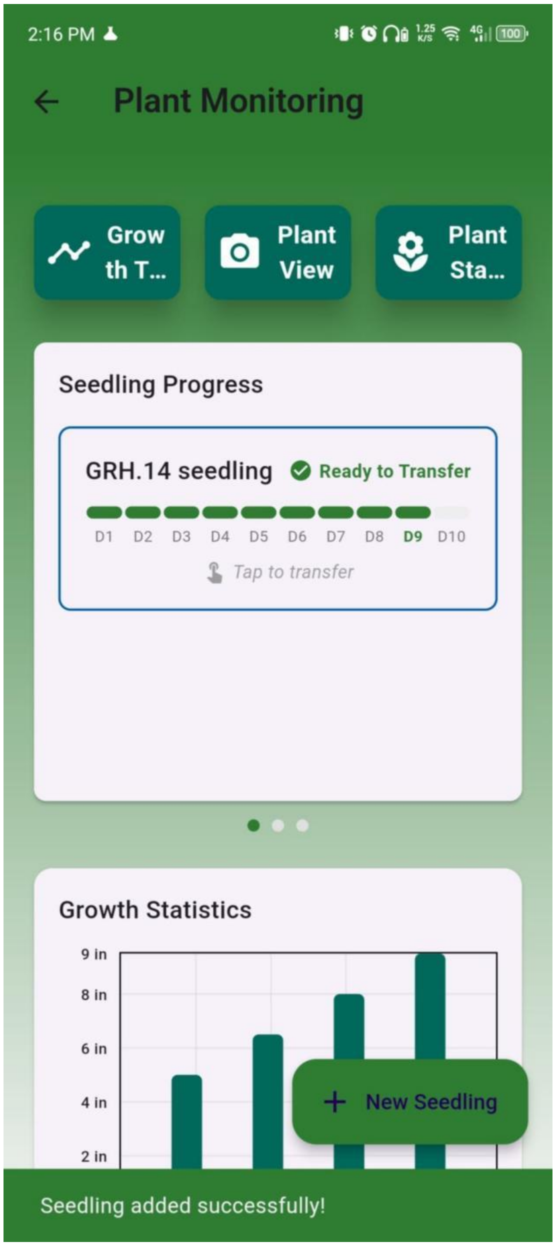

2:17 PM
pH Sensor Accuracy ...
pH Sensor Accuracy Test Checklist
1
Check the sensor connections
Ensure that the pH sensor is properly connected to the microcontroller. Check for loose wires or poor connections.
Pass
Fail
2
Clean the sensor with a dry cloth
3
Ensure sensor is within proper temperature range
4
Compare sensor readings with reference

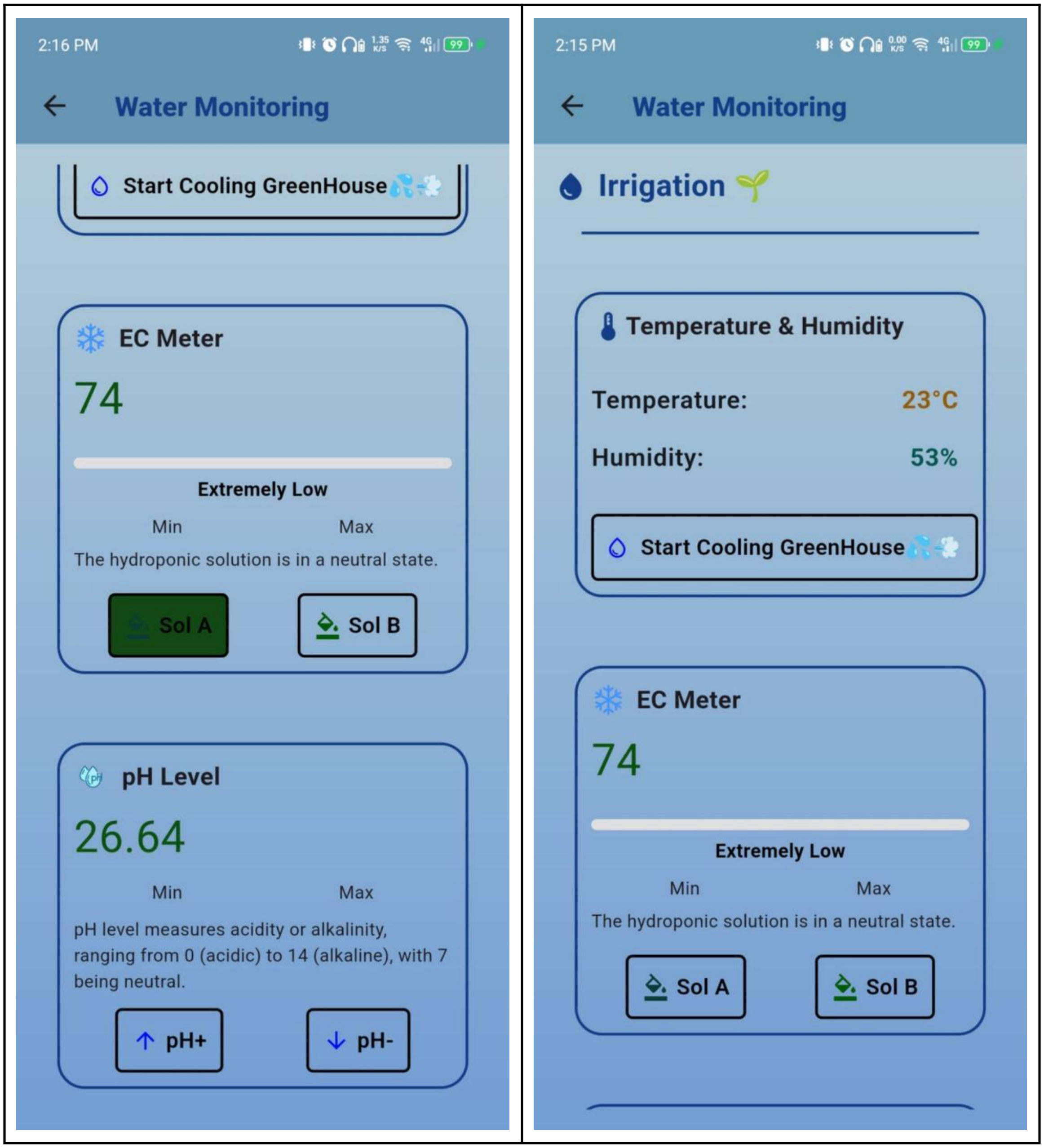

2:17 PM
DHT Sensor Accurac...
DHT Sensor Accuracy Test Checklist
1
Check the sensor connections
Ensure that the sensor is properly connected to the microcontroller. Check for loose wires or poor connections.
Pass
Fail
2
Clean the sensor with a dry cloth
3
Ensure sensor is within proper temperature range
4
Compare sensor readings with reference
2:17 PM
TDS Sensor Accurac...
TDS Sensor Accuracy Test Checklist
1
Check the sensor connections
Ensure that the TDS sensor is properly connected to the microcontroller. Check for loose wires or poor connections.
Pass
Fail
2
Clean the sensor with a dry cloth
3
Ensure sensor is within proper temperature range
4
Compare sensor readings with reference

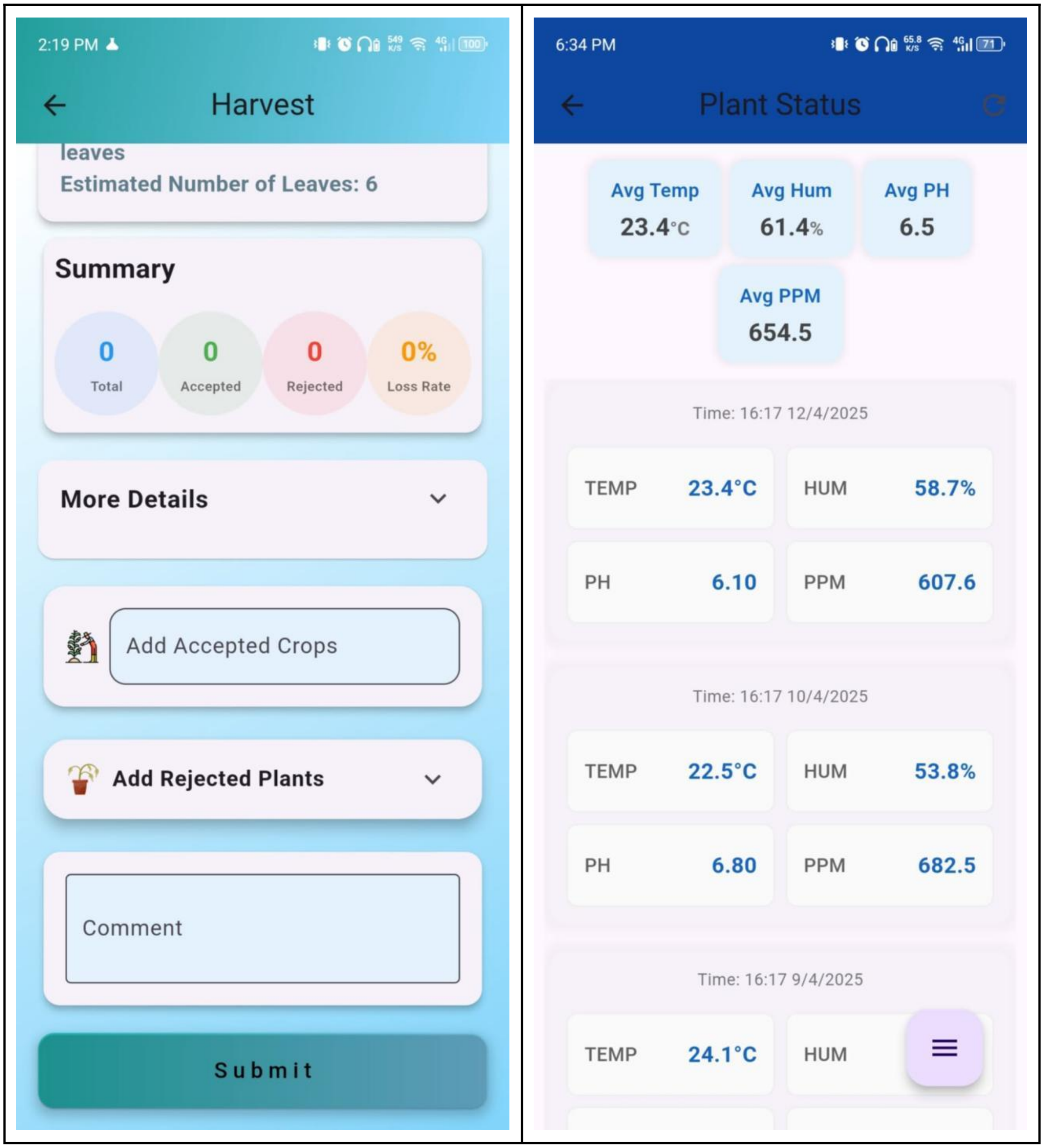

2:17 PM
Sensors and Components
No Urgent Checking Needed
Register New Component
1 Greenhouse 2 3
Select Greenhouse
Greenhouse ID
Email
markaropon@gmail.com
Continue
Cancel
Maintenance Logs:

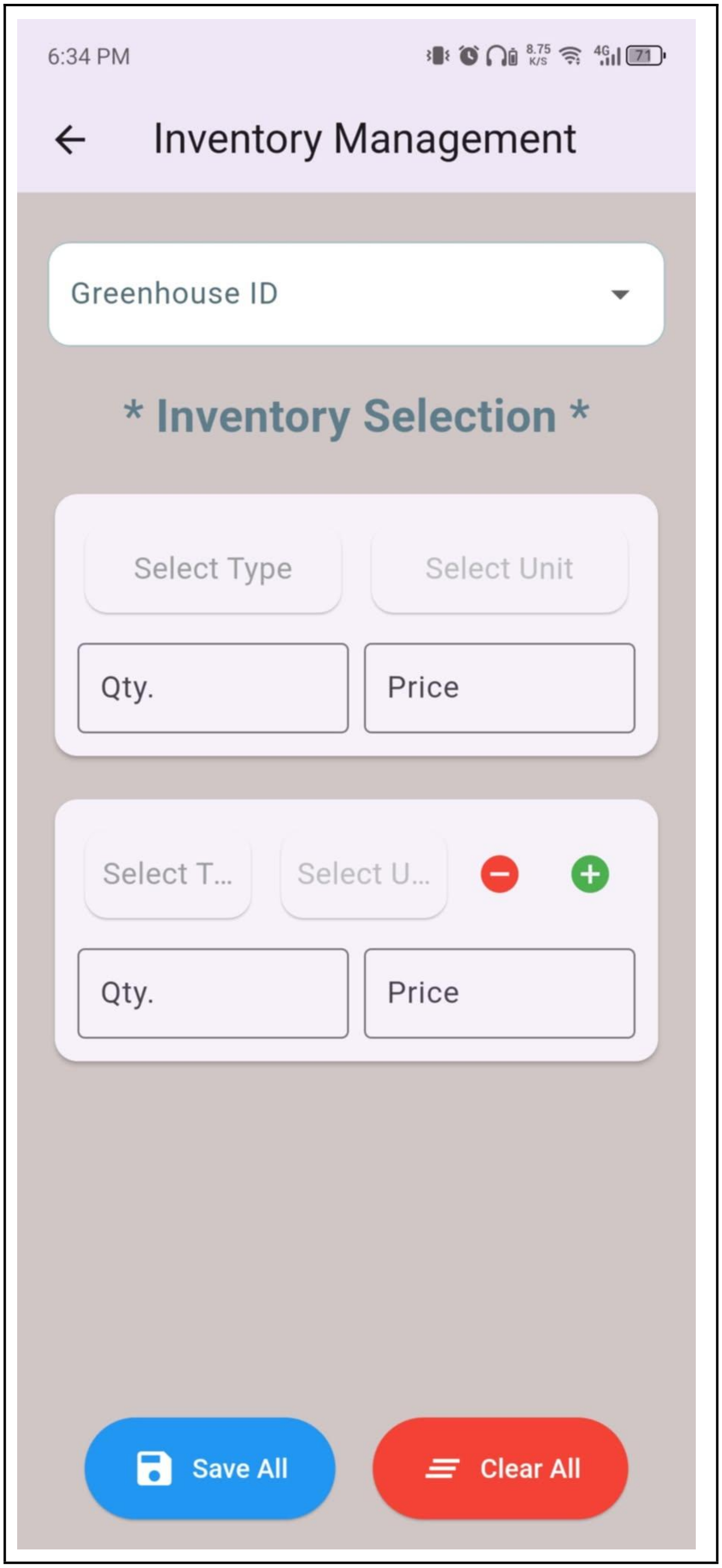

2:17 PM
Sensors and Components
No Urgent Checking Needed
TDS SENSOR
3 tests needed
New Component
Add Maintenance
GRH. Sensors & Actuator Status
Maintenance Logs:


2:16 PM
Plant Monitoring
Grow th T...
Plant View
Plant Sta...
TEMP
23.4°C
HUM
61.4%
PH
6.54
PPM
654.5
Temperature
Growth Statistics
Week 1
Week 2
Week 3
Week 4
New Seedling


2:16 PM
Plant Monitoring
Grow th T...
Plant View
Plant Sta...
Seedling Progress
GRH.14 seedling
Ready to Transfer
D1 D2 D3 D4 D5 D6 D7 D8 D9 D10
Tap to transfer
Growth Statistics
New Seedling
Seedling added successfully!


2:16 PM
Water Monitoring
Start Cooling GreenHouse
EC Meter
74
Extremely Low
Min
Max
The hydroponic solution is in a neutral state.
Sol A
Sol B
pH Level
26.64
Min
Max
pH level measures acidity or alkalinity, ranging from 0 (acidic) to 14 (alkaline), with 7 being neutral.
pH+
pH-
2:15 PM
Water Monitoring
Irrigation
Temperature & Humidity
Temperature:
23°C
Humidity:
53%
Start Cooling GreenHouse
EC Meter
74
Extremely Low
Min
Max
The hydroponic solution is in a neutral state.
Sol A
Sol B


2:19 PM
Harvest
leaves
Estimated Number of Leaves: 6
Summary
0 Total
0 Accepted
0 Rejected
0% Loss Rate
More Details
Add Accepted Crops
Add Rejected Plants
Comment
Submit
6:34 PM
Plant Status
Avg Temp 23.4°C
Avg Hum 61.4%
Avg PH 6.5
Avg PPM 654.5
Time: 16:17 12/4/2025
TEMP 23.4°C
HUM 58.7%
PH 6.10
PPM 607.6
Time: 16:17 10/4/2025
TEMP 22.5°C
HUM 53.8%
PH 6.80
PPM 682.5
Time: 16:17 9/4/2025
TEMP 24.1°C
HUM


6:34 PM
Inventory Management
Greenhouse ID
* Inventory Selection *
Select Type
Select Unit
Qty.
Price
Select T...
Select U...
Qty.
Price
Save All
Clear All

APPENDIX C

User Manual

Table of Contents

Web Application

Login

This is where the user can input their login credentials.

Reset Password

If the user forgets their password they can click this button below the password field, it will then require the user to input their email to verify their account.

After the user verifies their account, they can change their password by creating a new one and confirming it.

1

User Manual

Web Application

Main Dashboard

After they login they will be greeted with the AGREEMO dashboard where it contains data and graphs from their greenhouse.

Navigation Bar

The user can use the sidebar to navigate the harvests items tab to see how many harvests have been accepted, rejected, total yield, and lose rate.

The user can pick which table they want to see from harvested and rejected, the user can also filter when it was harvested.

Below harvests items the user will see the reports of the actions a user from the mobile application made in a table.

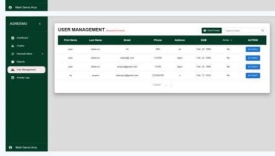
2

AGREEMO

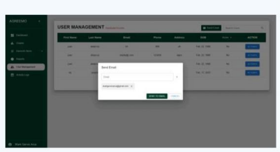
Web Application

User Management

The user can also manage accounts in the user management tab where



they can deactivate specific accounts and send email.



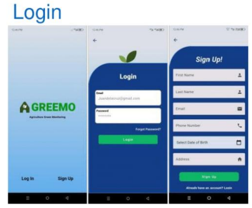
3

Mobile Application

Installation

- Locate the APK file from your file manager app. Navigate to the folder where you saved the AGREEMO APK file.
- Tap on the AGREEMO APK file to initiate installation.
- Grant permissions that android will likely ask you to grant to install unknown apps.
- Review permissions then tap "Install" if you are comfortable with the permissions.
- The Installation process will begin and wait for it to finish.
- Open AGREEMO once the installation is finished.

Login



The user will need to input their credentials to sign up and login to be able to use the features of the mobile application.

4

AGREEMO

Mobile Application

Main Dashboard

Upon opening the app, the user can interact with different buttons to check, monitor and control the machines inside the greenhouse and its harvests.

The user can scroll down to see the water levels inside the containers in the greenhouse

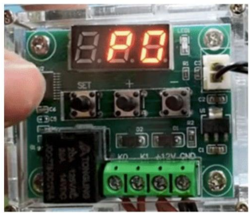
Control Tab

When the user presses the control button, they can see the different buttons to turn on and off the machine inside the greenhouse

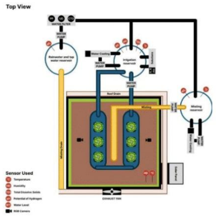
5

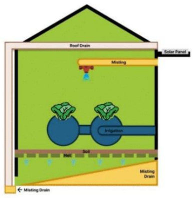
User Manual

Hardware



The user can set the temperature on the cooling device by pressing on the set and holding it for 5 seconds then it will show PO, the user will need to select "C" for Cooling then press the set button again to show the current temperature then the minus button to lower the temperature and plus button to make it higher.



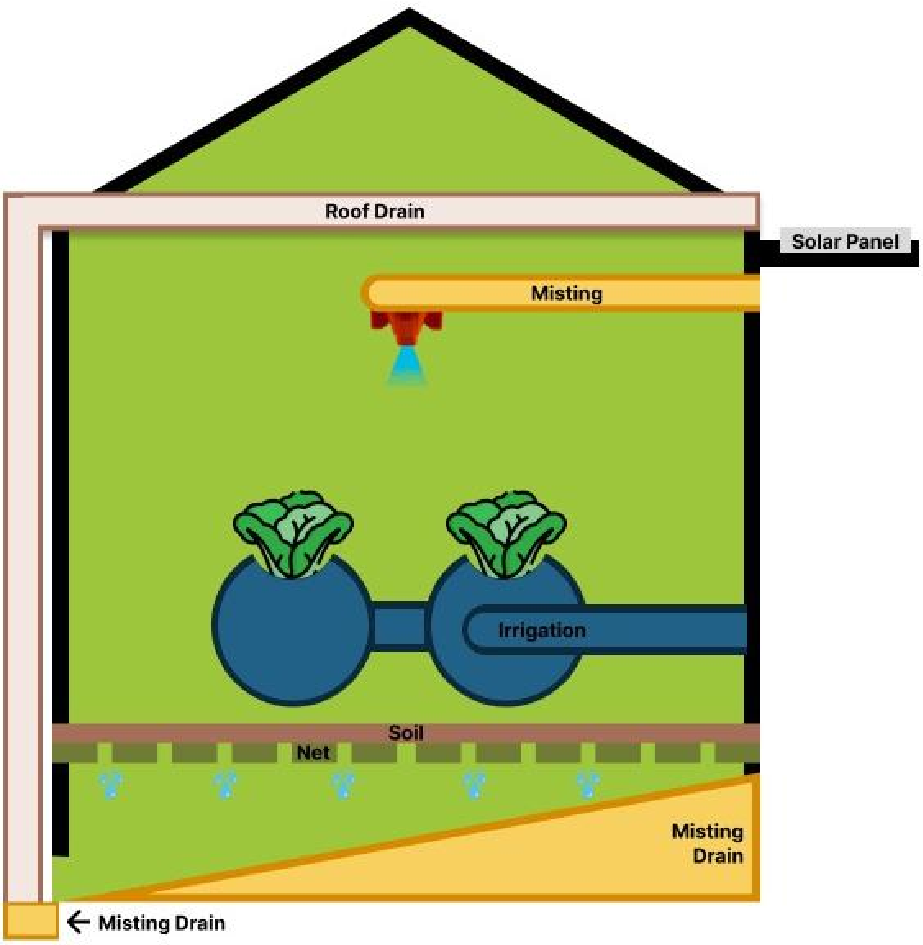


6

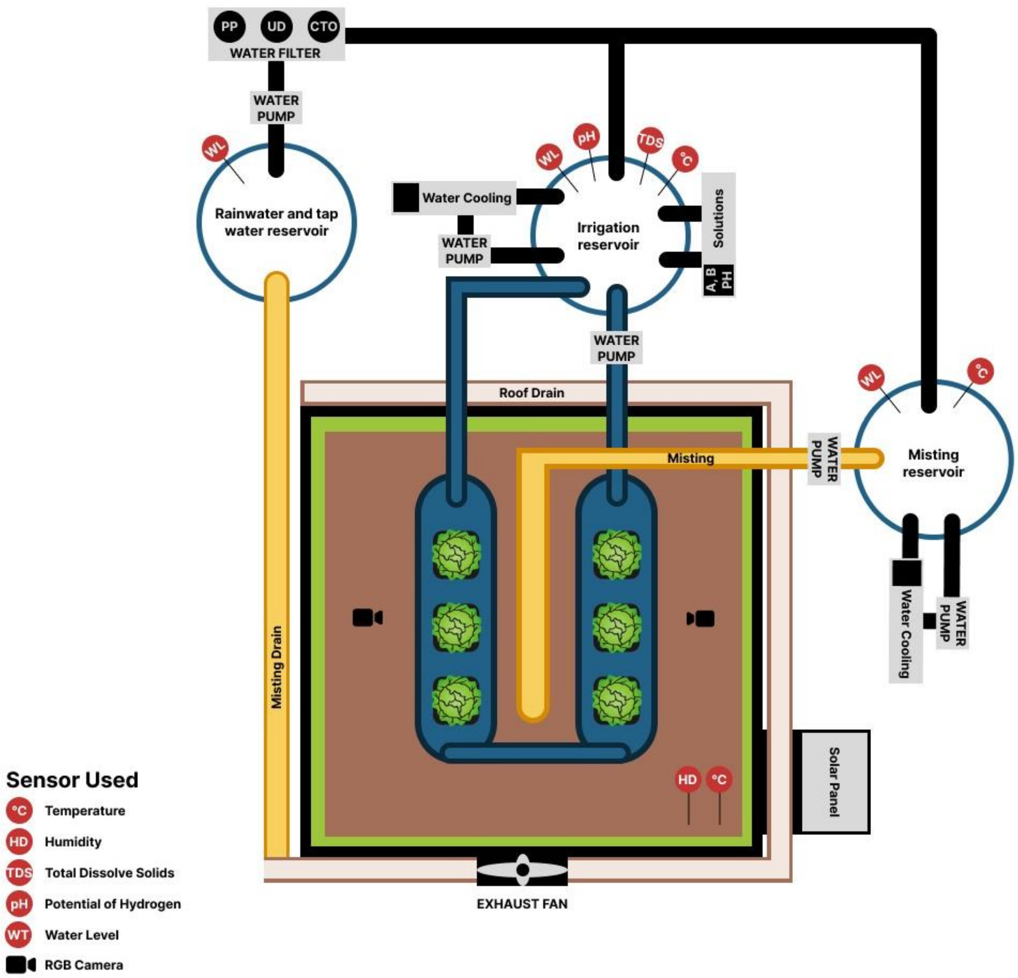
APPENDIX D

Hydroponics Greenhouse Prototype Model

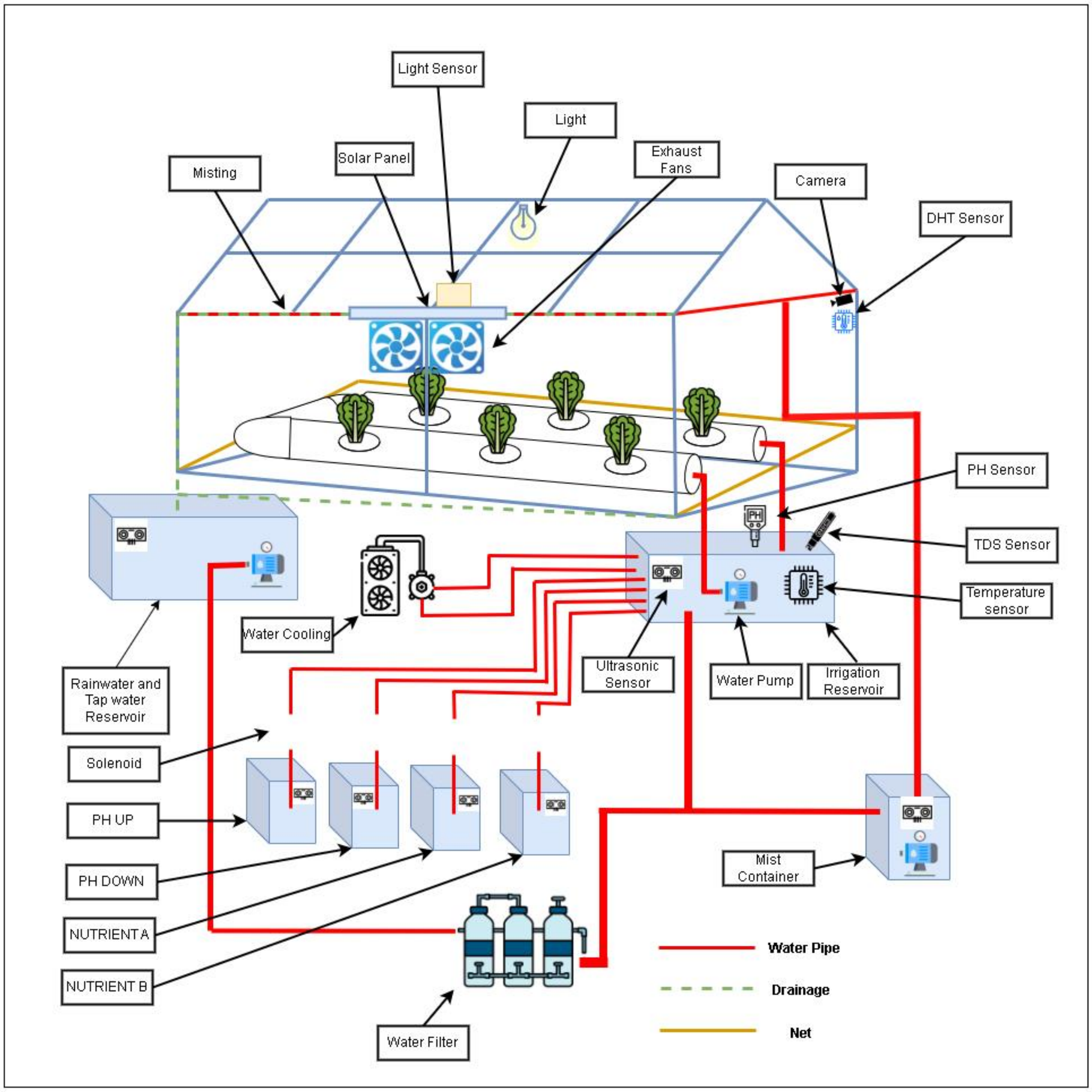
Side View



Top View


PP
UD
CTO
WATER FILTER
WATER PUMP
WL
Rainwater and tap water reservoir
Water Cooling
WATER PUMP
pH
TDS
°C
Irrigation reservoir
Solutions
A, B PH
WATER PUMP
Roof Drain
Misting
WATER PUMP
Misting reservoir
Water Cooling
Misting Drain
HD
Solar Panel
EXHAUST FAN
Sensor Used
Temperature
Humidity
Total Dissolve Solids
Potential of Hydrogen
WT
Water Level
RGB Camera

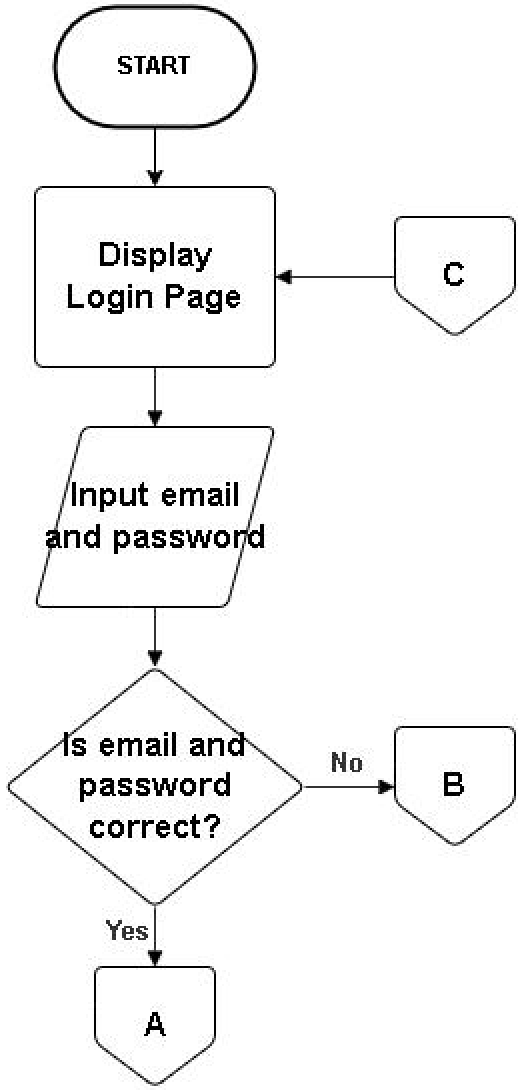
Hydroponics Greenhouse Model

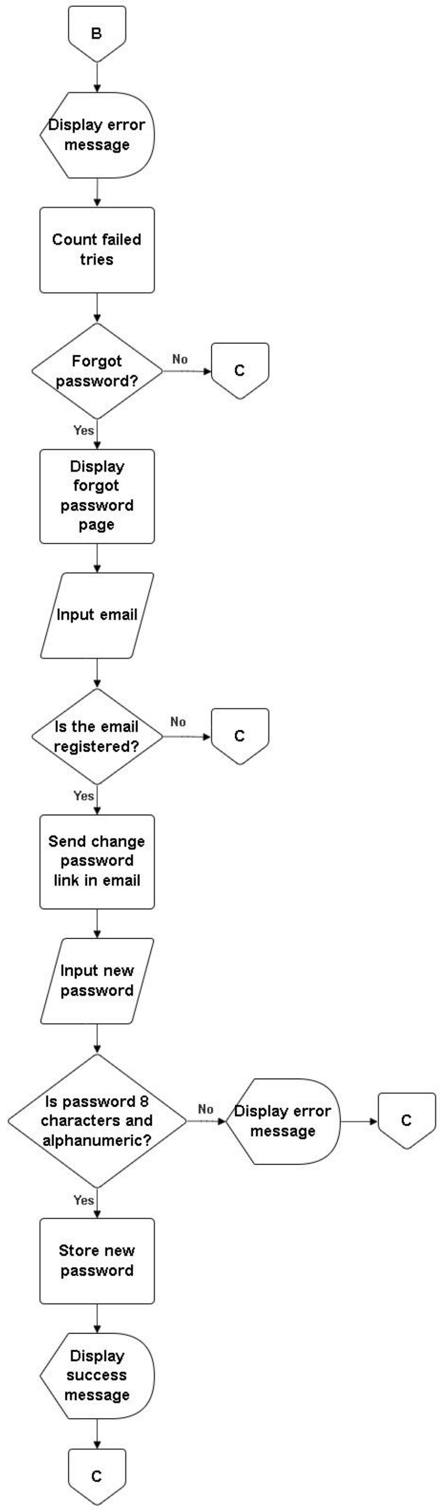


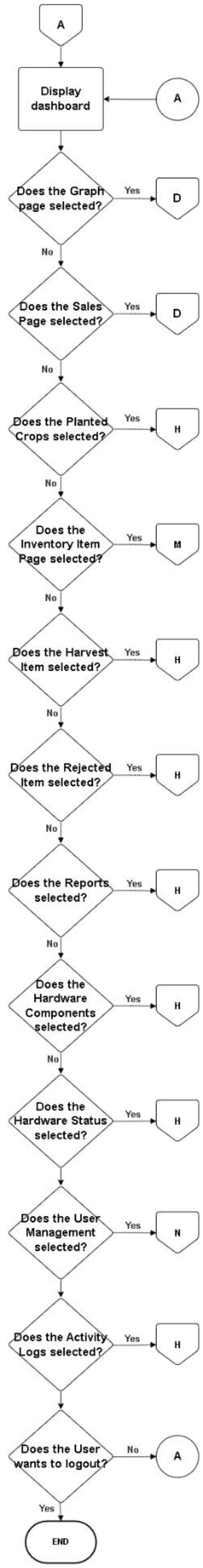
APPENDIX E

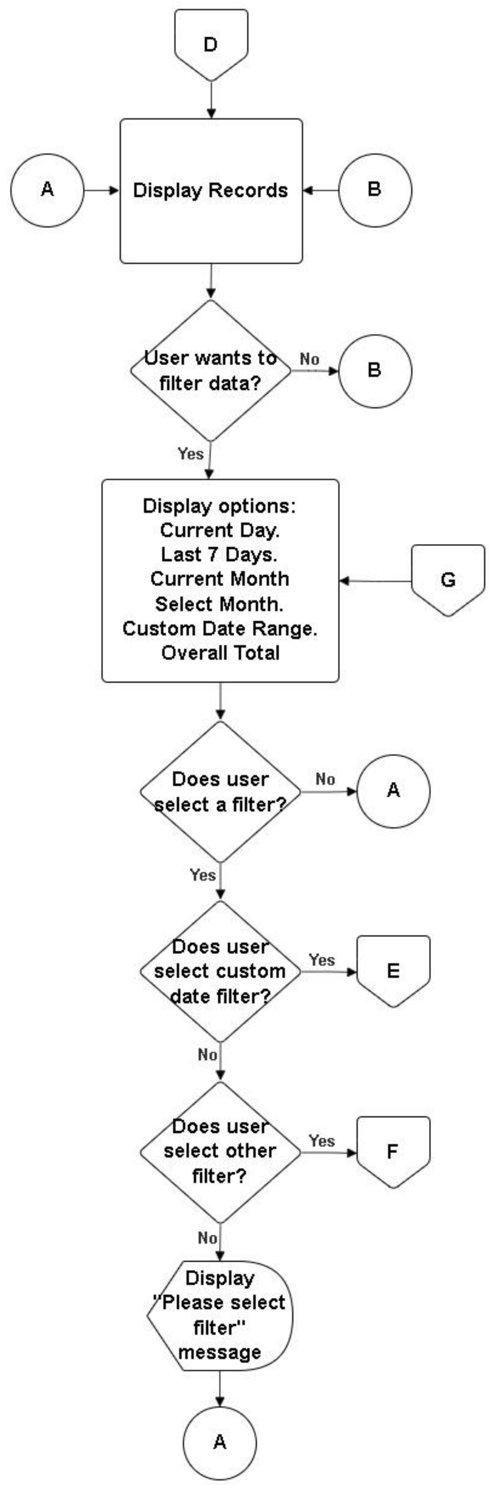
Diagrams

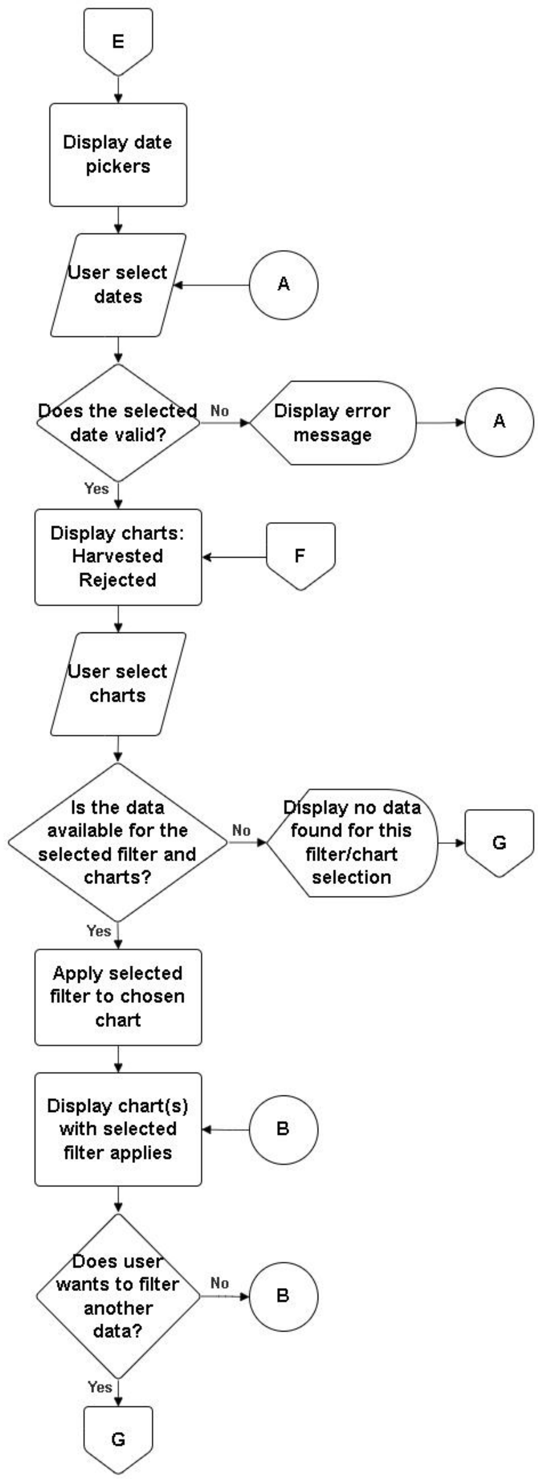
System Flowchart

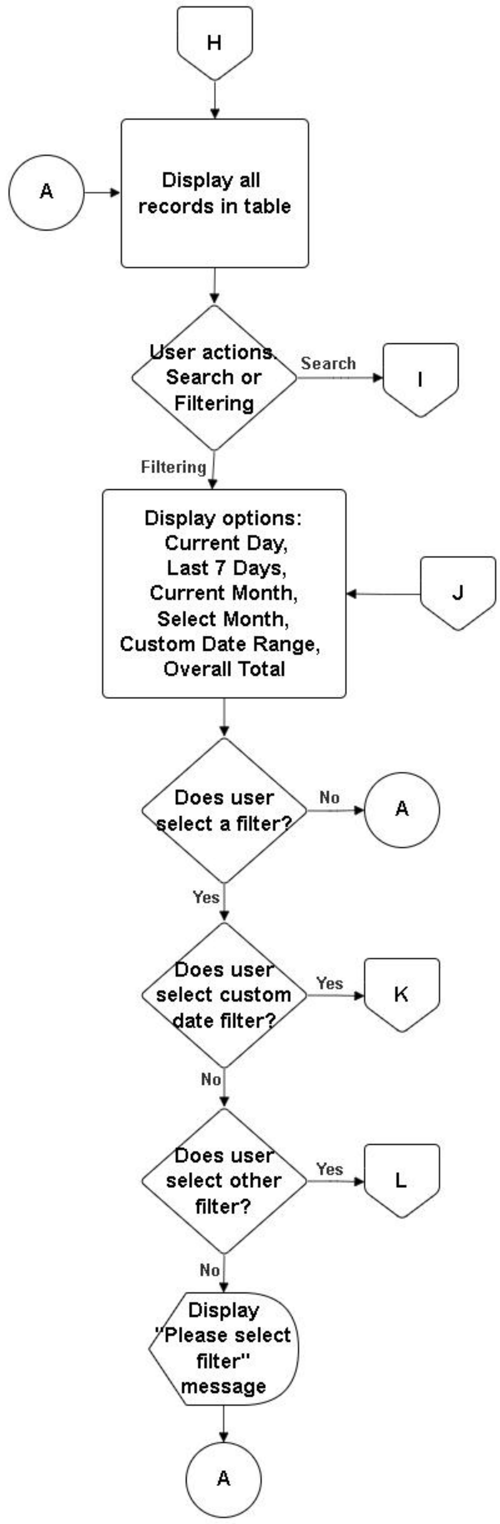


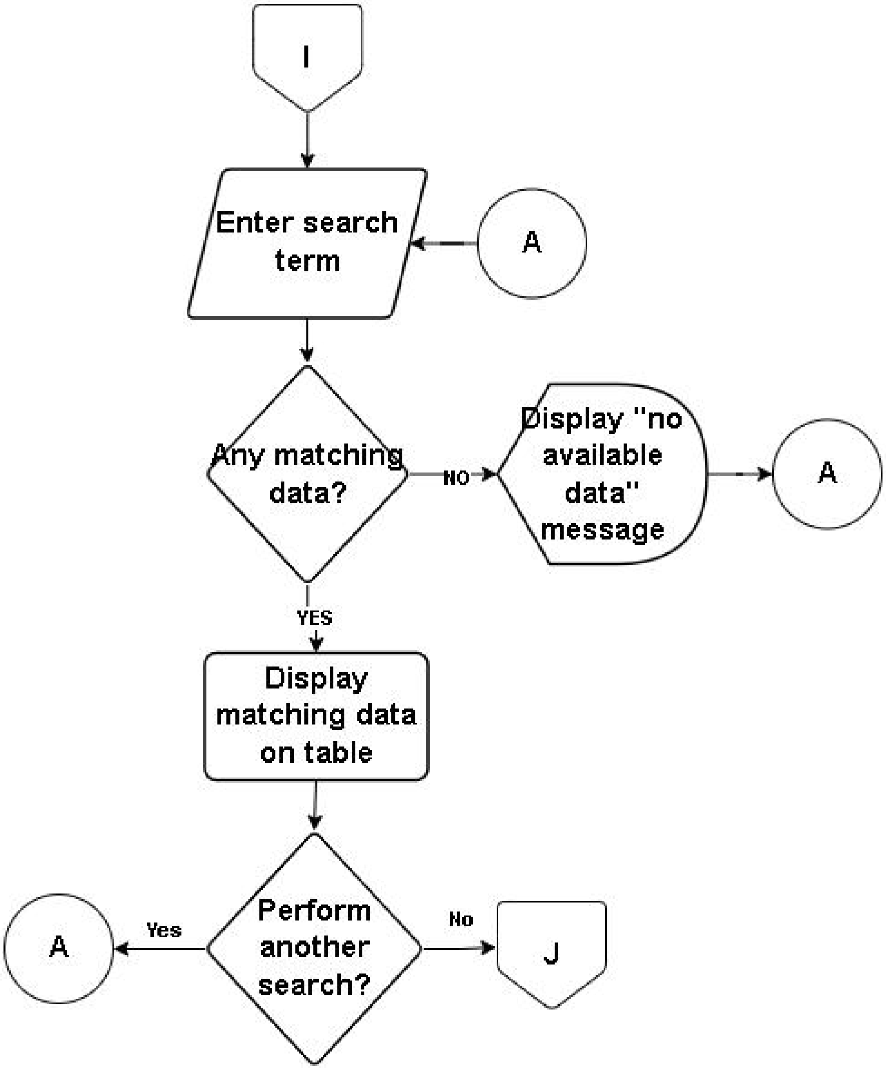

B
Display error message
Count failed tries
Forgot password?
No
C
Yes
Display forgot password page
Input email
Is the email registered?
No
C
Yes
Send change password link in email
Input new password
Is password 8 characters and alphanumeric?
No
Display error message
C
Yes
Store new password
Display success message
C

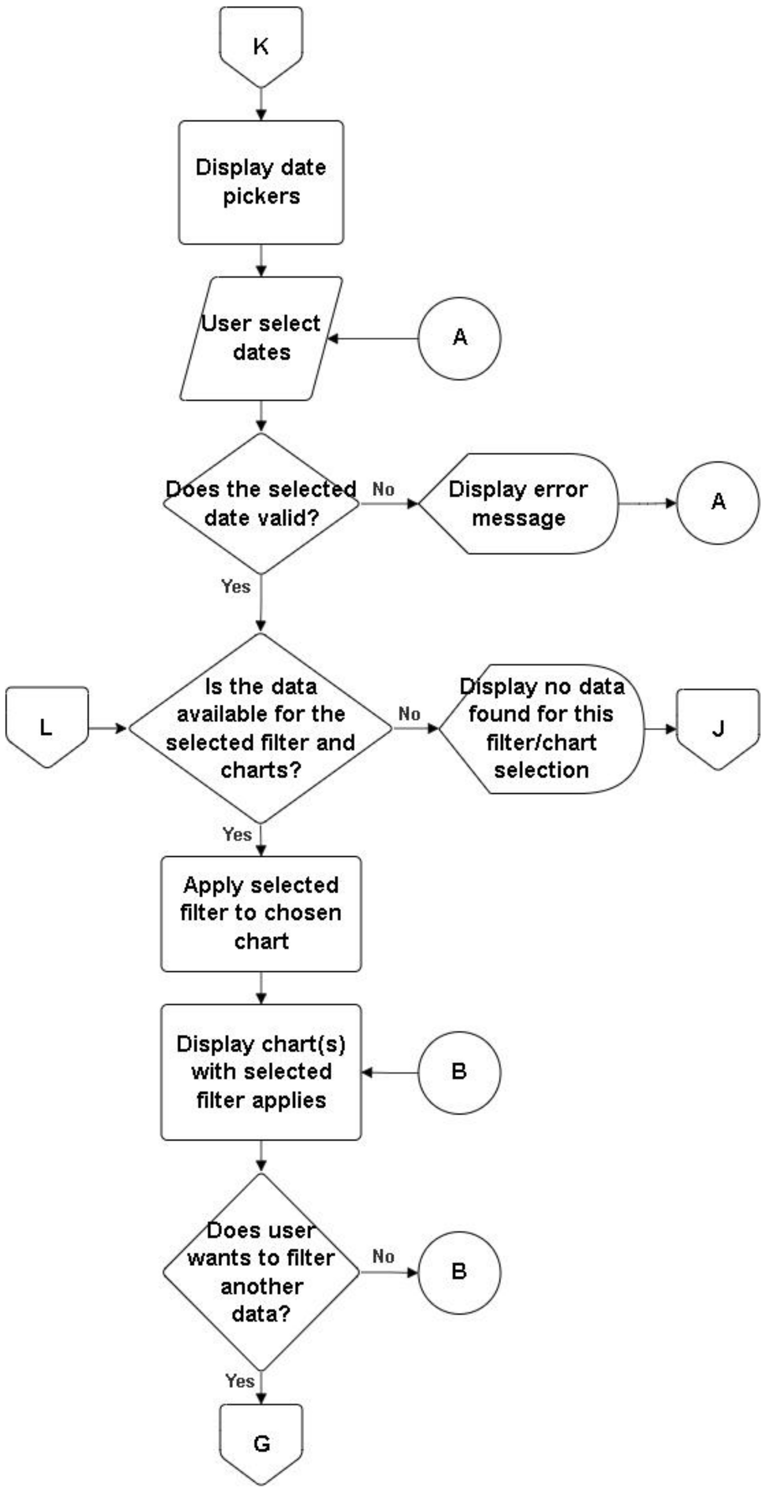

A
Display dashboard
A
Does the Graph page selected?
Yes
D
No
Does the Sales Page selected?
Yes
D
No
Does the Planted Crops selected?
Yes
H
No
Does the Inventory Item Page selected?
Yes
M
No
Does the Harvest Item selected?
Yes
H
No
Does the Rejected Item selected?
Yes
H
No
Does the Reports selected?
Yes
H
No
Does the Hardware Components selected?
Yes
H
No
Does the Hardware Status selected?
Yes
H
Does the User Management selected?
Yes
N
Does the Activity Logs selected?
Yes
H
Does the User wants to logout?
No
A
Yes
END

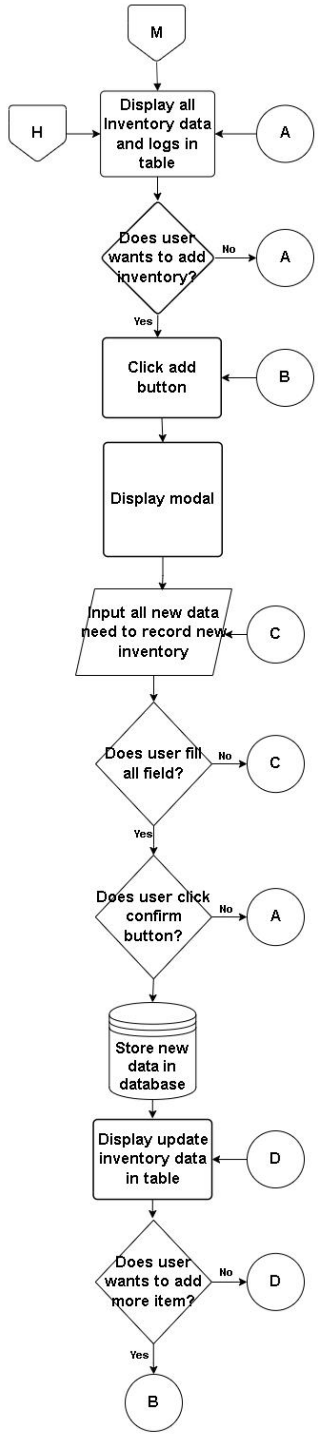

D
A
Display Records
B
User wants to filter data?
No
B
Yes
Display options:
Current Day.
Last 7 Days.
Current Month
Select Month.
Custom Date Range.
Overall Total
G
Does user select a filter?
No
A
Yes
Does user select custom date filter?
Yes
E
No
Does user select other filter?
Yes
F
No
Display "Please select filter" message
A

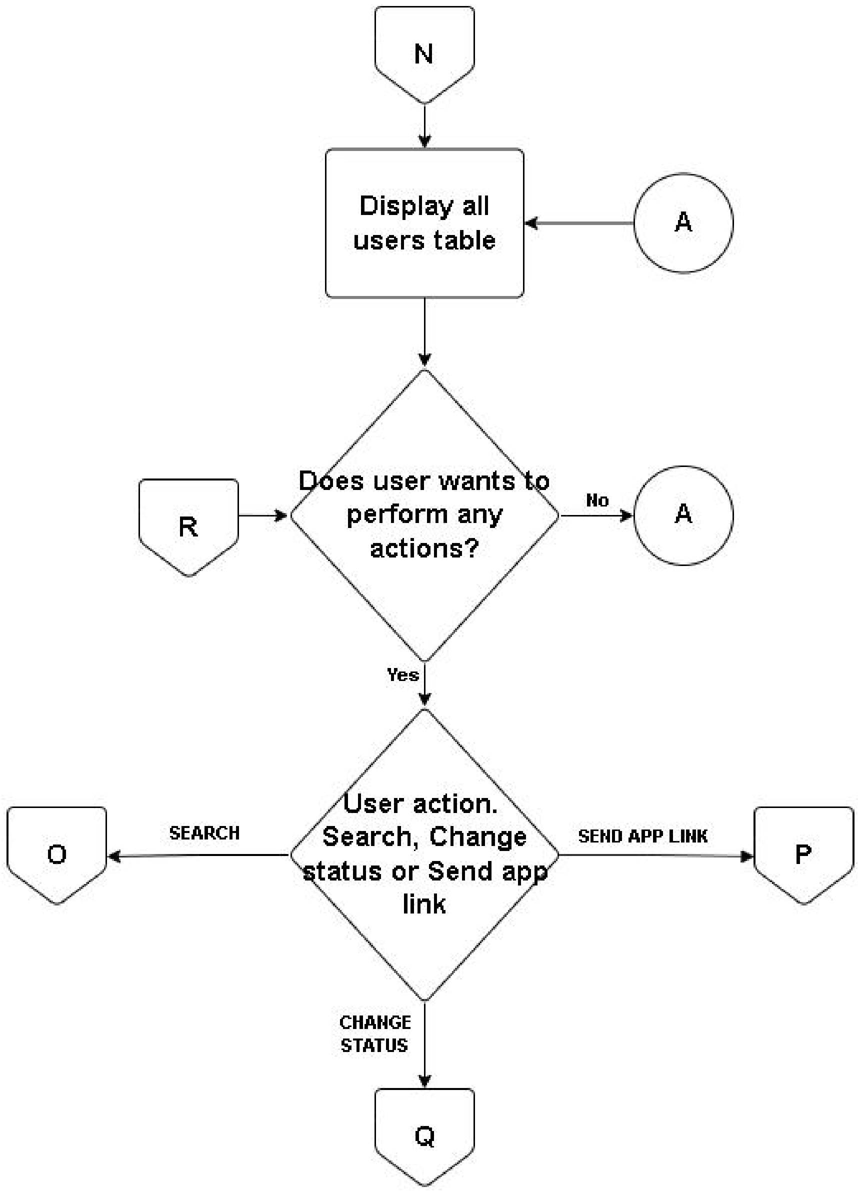

E
Display date pickers
User select dates
A
Does the selected date valid?
No
Display error message
A
Yes
Display charts: Harvested Rejected
F
User select charts
Is the data available for the selected filter and charts?
No
Display no data found for this filter/chart selection
G
Yes
Apply selected filter to chosen chart
Display chart(s) with selected filter applies
B
Does user wants to filter another data?
No
B
Yes
G

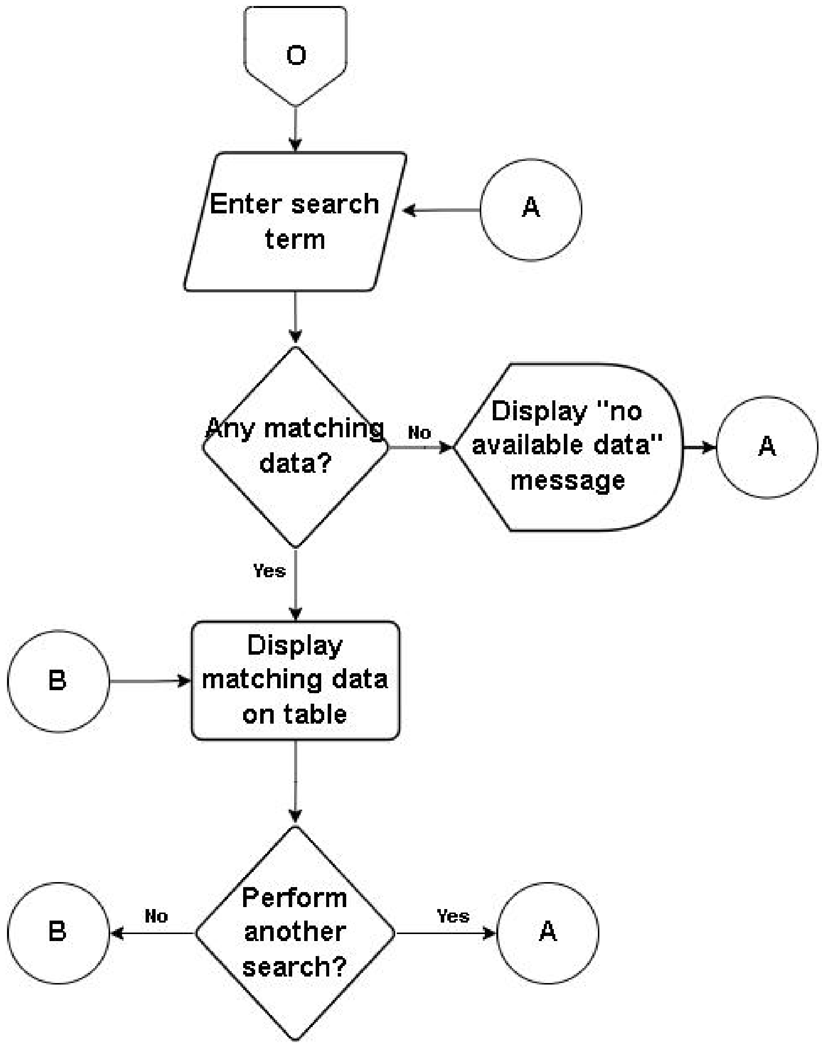

H
A
Display all records in table
User actions Search or Filtering
Search
I
Filtering
Display options: Current Day, Last 7 Days, Current Month, Select Month, Custom Date Range, Overall Total
J
Does user select a filter?
No
A
Yes
Does user select custom date filter?
Yes
K
No
Does user select other filter?
Yes
L
No
Display "Please select filter" message
A

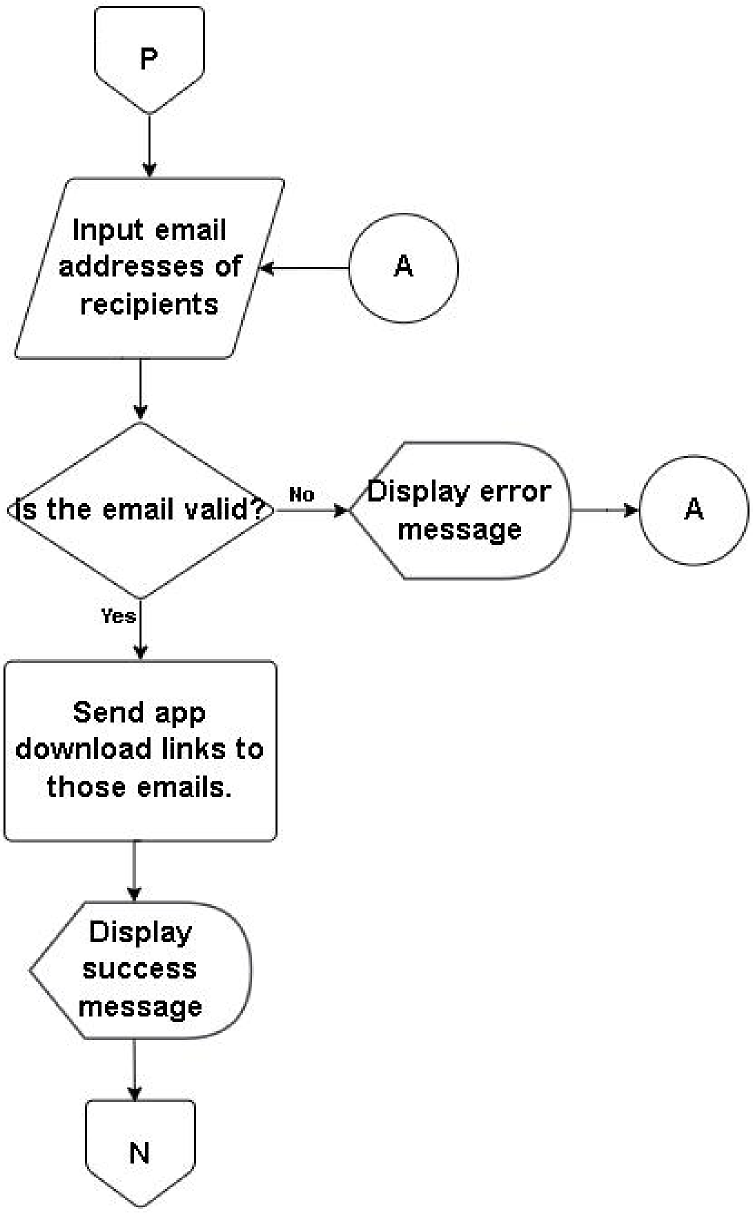

I
Enter search term
A
Any matching data?
NO
Display "no available data" message
A
YES
Display matching data on table
Perform another search?
Yes
A
No
J

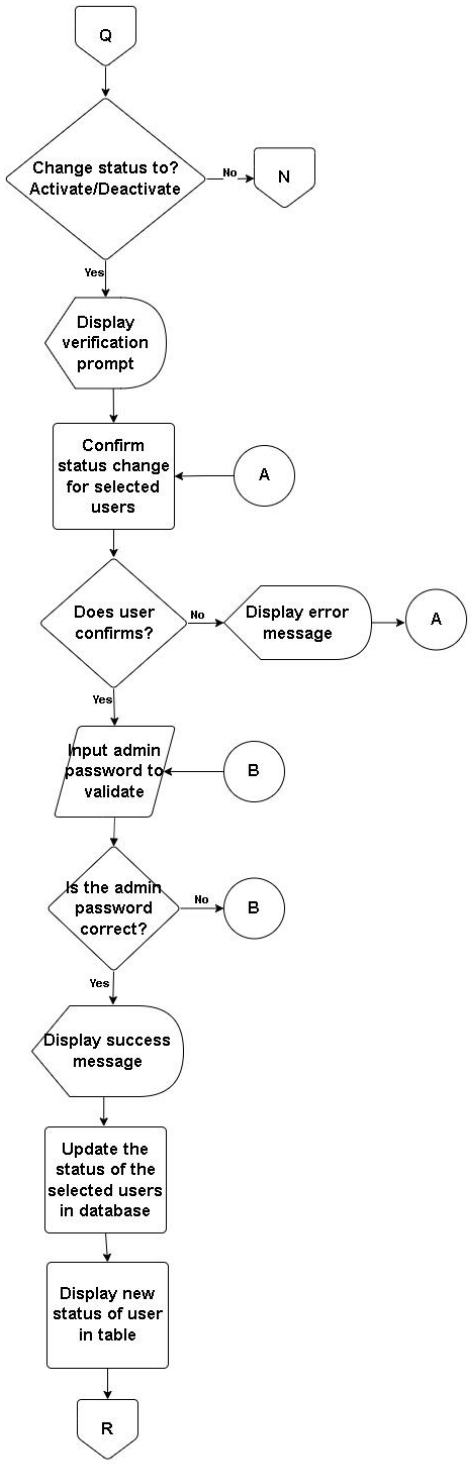

K
Display date pickers
User select dates
A
Does the selected date valid?
No
Display error message
A
Yes
L
Is the data available for the selected filter and charts?
No
Display no data found for this filter/chart selection
J
Yes
Apply selected filter to chosen chart
Display chart(s) with selected filter applies
B
Does user wants to filter another data?
No
B
Yes
G


M
H
Display all Inventory data and logs in table
A
Does user wants to add inventory?
No
A
Yes
Click add button
B
Display modal
Input all new data need to record new inventory
C
Does user fill all field?
No
C
Yes
Does user click confirm button?
No
A
Store new data in database
Display update inventory data in table
D
Does user wants to add more item?
No
D
Yes
B

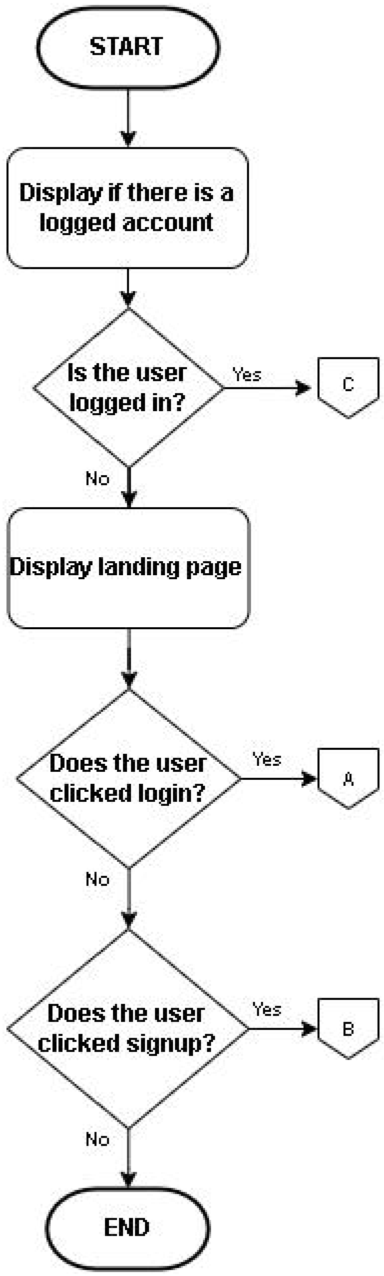

N
Display all users table
A
R
Does user wants to perform any actions?
No
A
Yes
O
SEARCH
User action. Search, Change status or Send app link
SEND APP LINK
P
CHANGE STATUS
Q

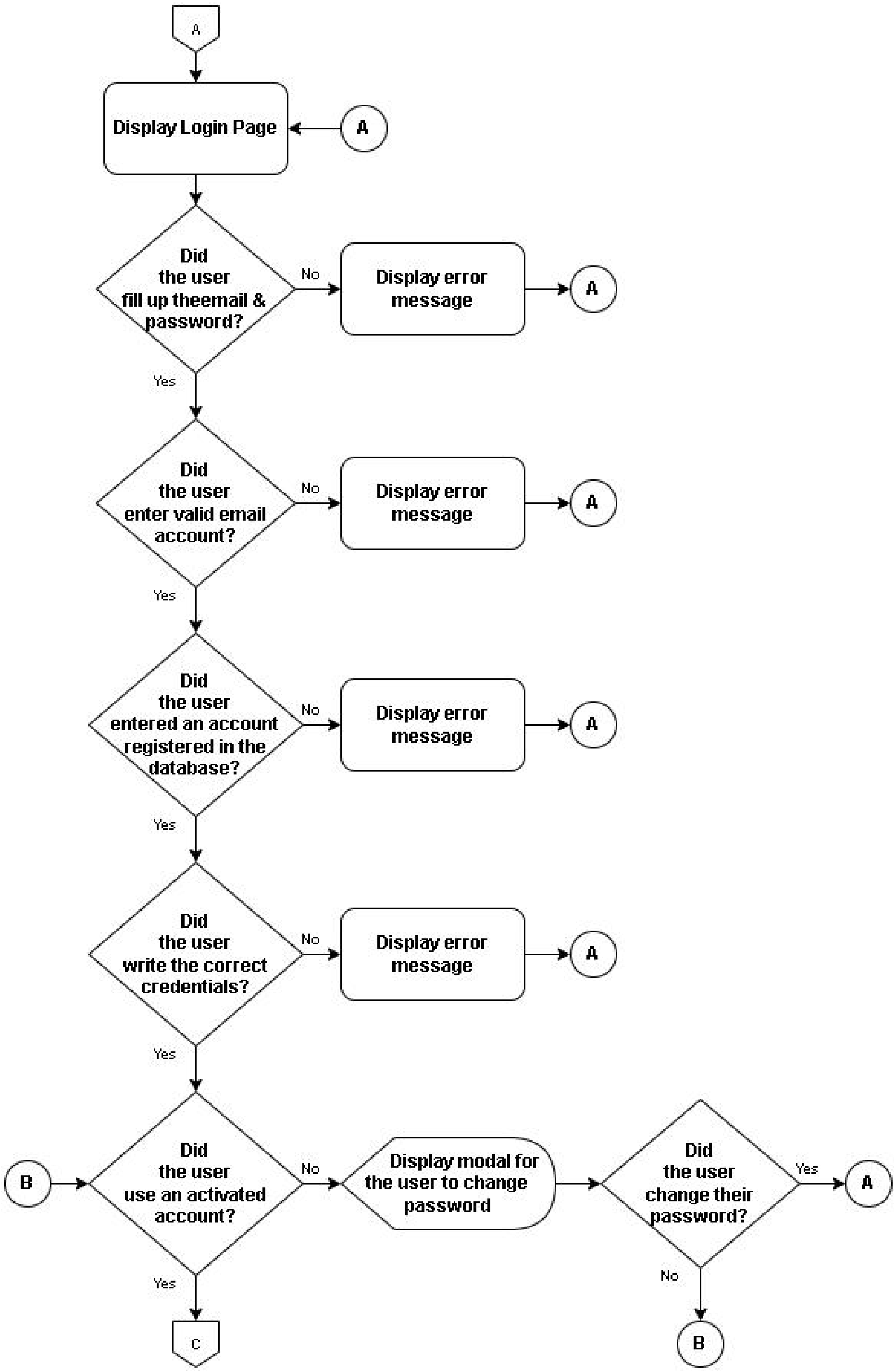

O
Enter search term
A
Any matching data?
No
Display "no available data" message
A
Yes
B
Display matching data on table
B
No
Perform another search?
Yes
A

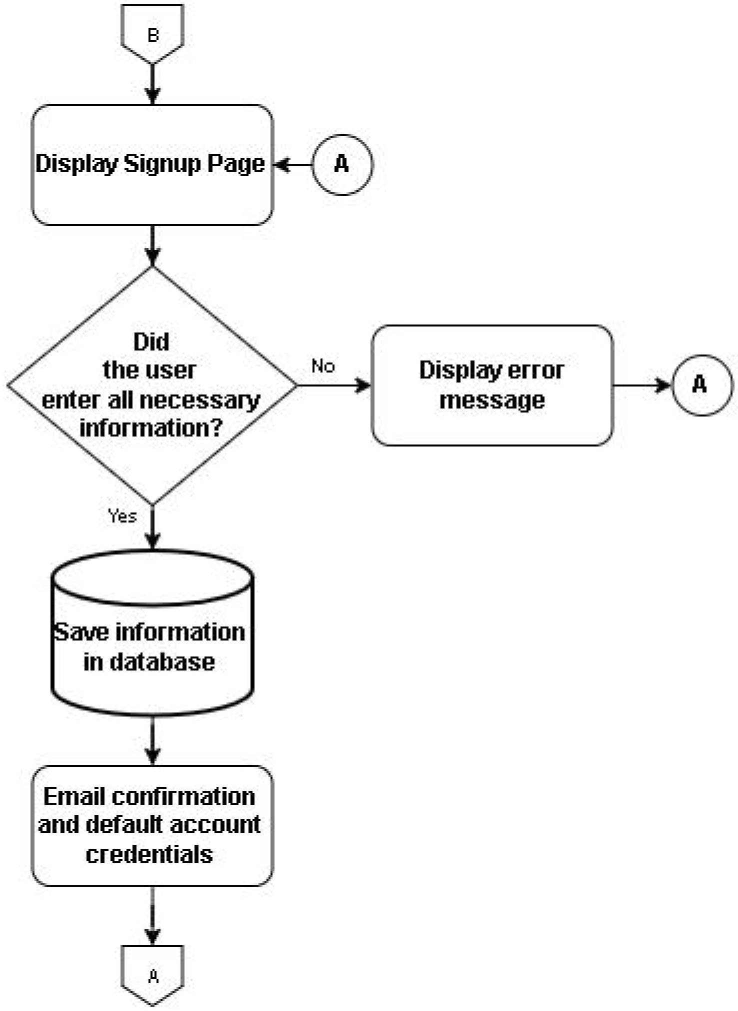

P
Input email addresses of recipients
A
Is the email valid?
No
Display error message
A
Yes
Send app download links to those emails.
Display success message
N

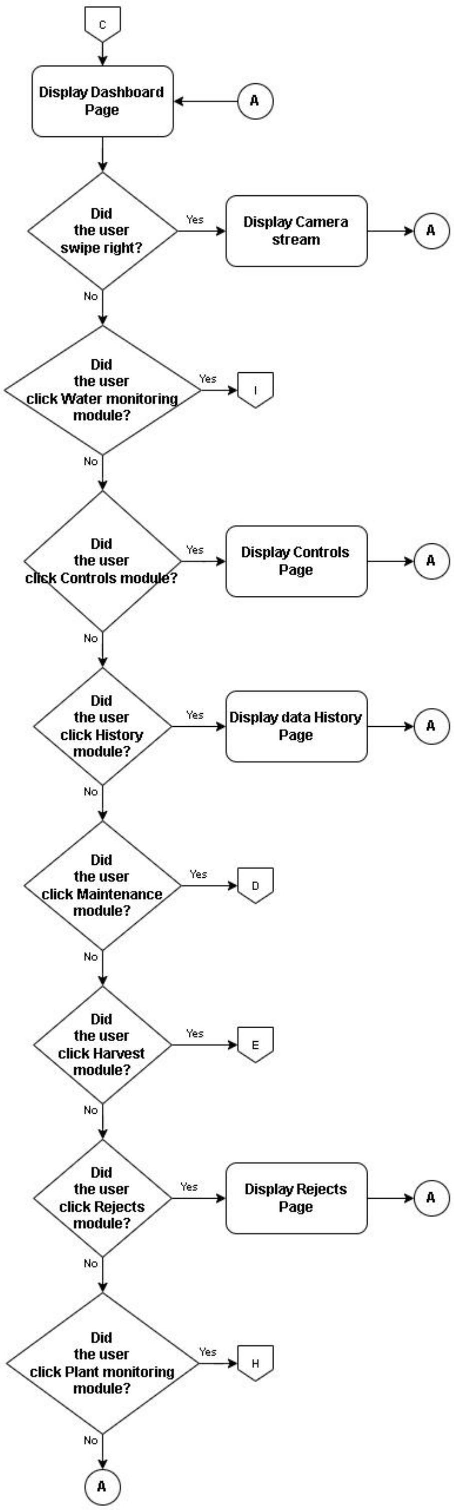

Q
Change status to? Activate/Deactivate
No
N
Yes
Display verification prompt
Confirm status change for selected users
A
Does user confirms?
No
Display error message
A
Yes
Input admin password to validate
B
Is the admin password correct?
No
B
Yes
Display success message
Update the status of the selected users in database
Display new status of user in table
R

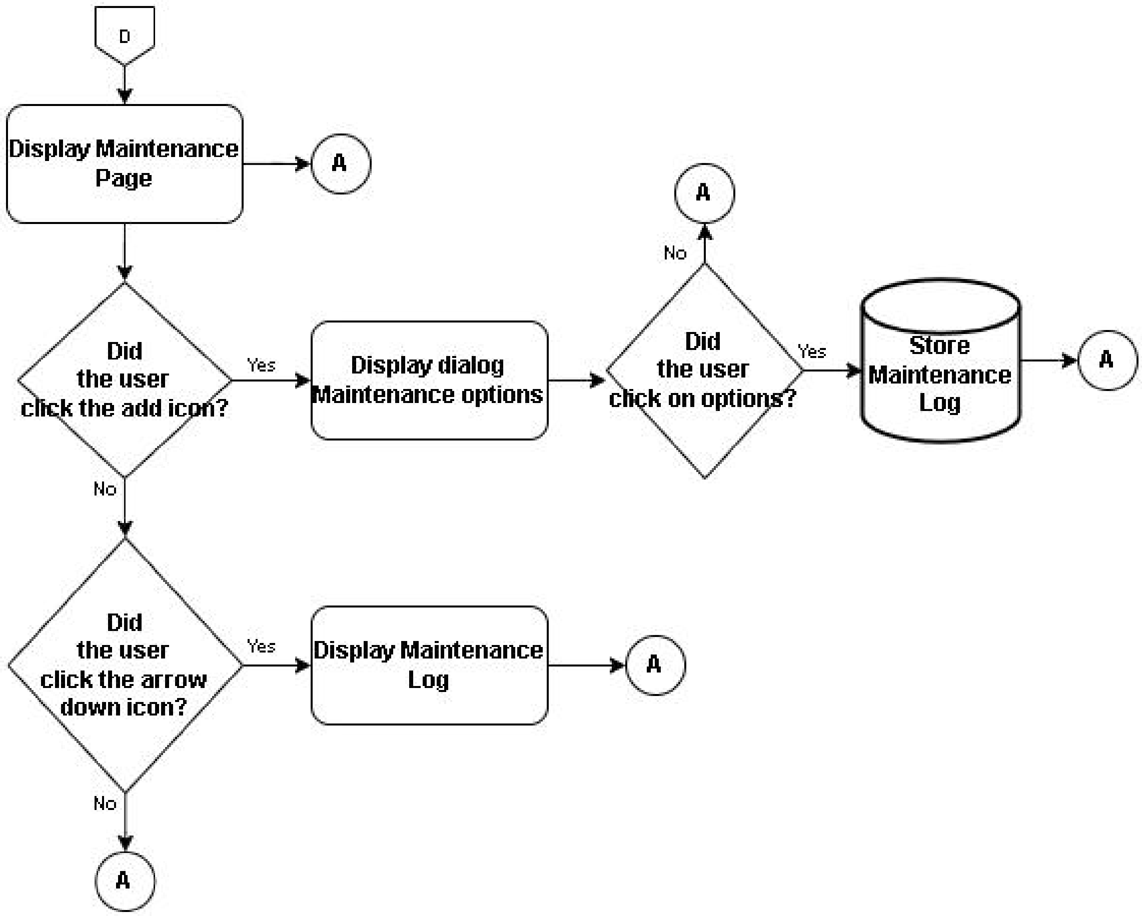
Mobile

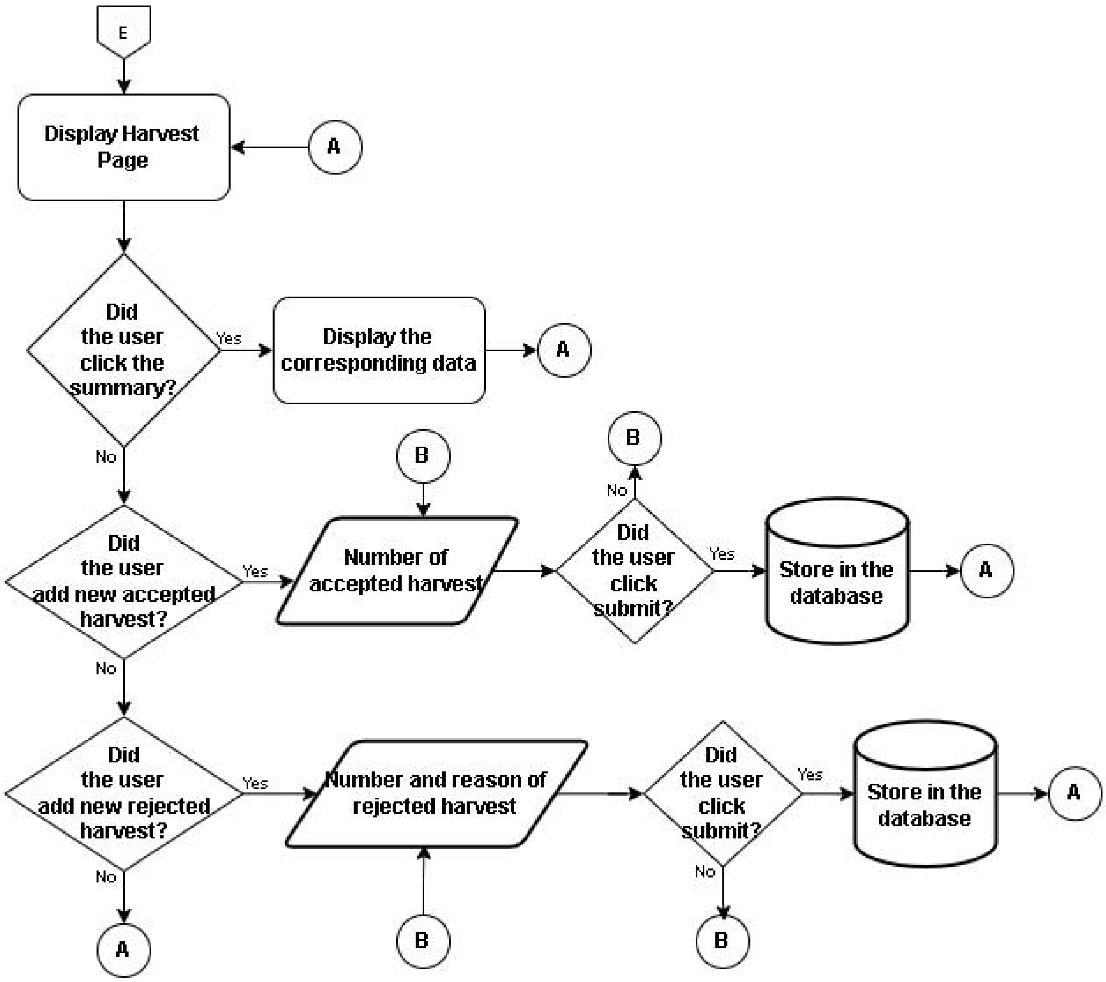

START
Display if there is a logged account
Is the user logged in?
Yes
C
No
Display landing page
Does the user clicked login?
Yes
A
No
Does the user clicked signup?
Yes
B
No
END

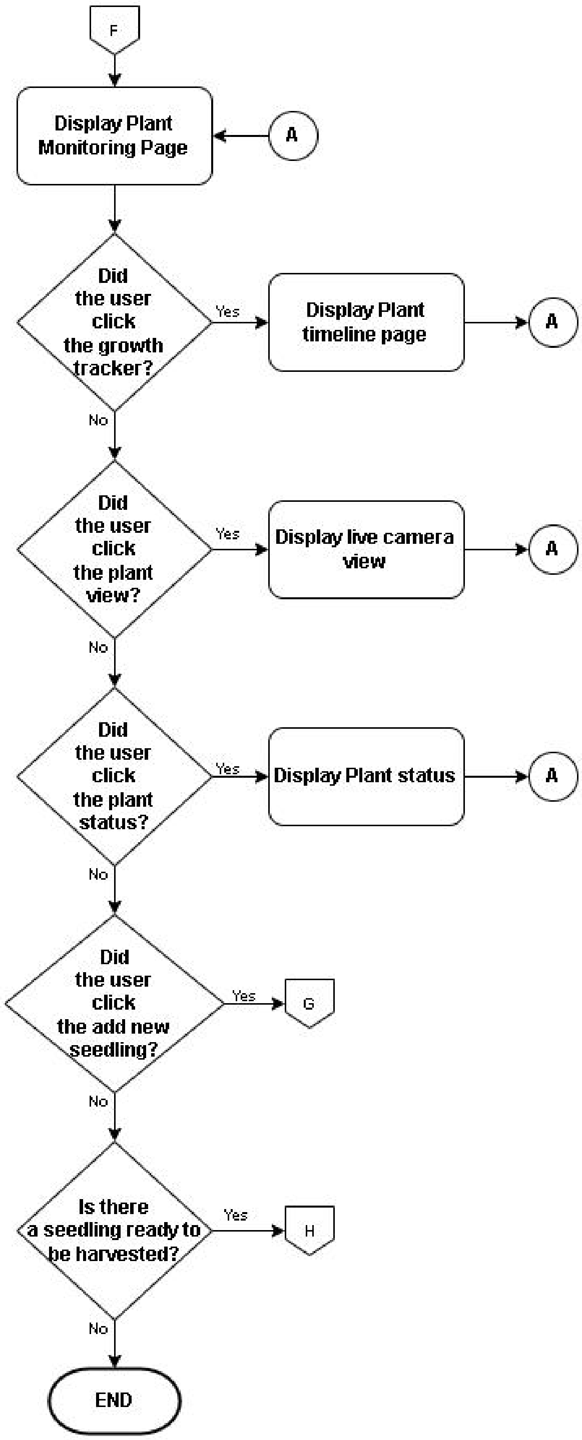

A
Display Login Page
A
Did the user fill up theemail & password?
No
Display error message
A
Yes
Did the user enter valid email account?
No
Display error message
A
Yes
Did the user entered an account registered in the database?
No
Display error message
A
Yes
Did the user write the correct credentials?
No
Display error message
A
Yes
B
Did the user use an activated account?
No
Display modal for the user to change password
Did the user change their password?
Yes
A
No
B
Yes
C

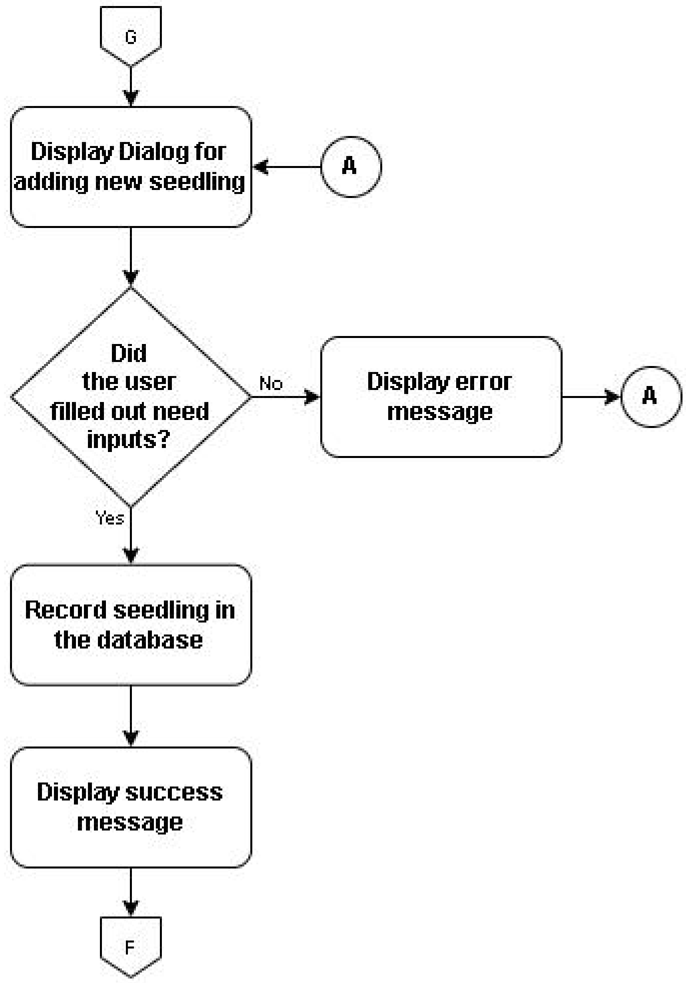

B
Display Signup Page
A
Did the user enter all necessary information?
No
Display error message
A
Yes
Save information in database
Email confirmation and default account credentials
A

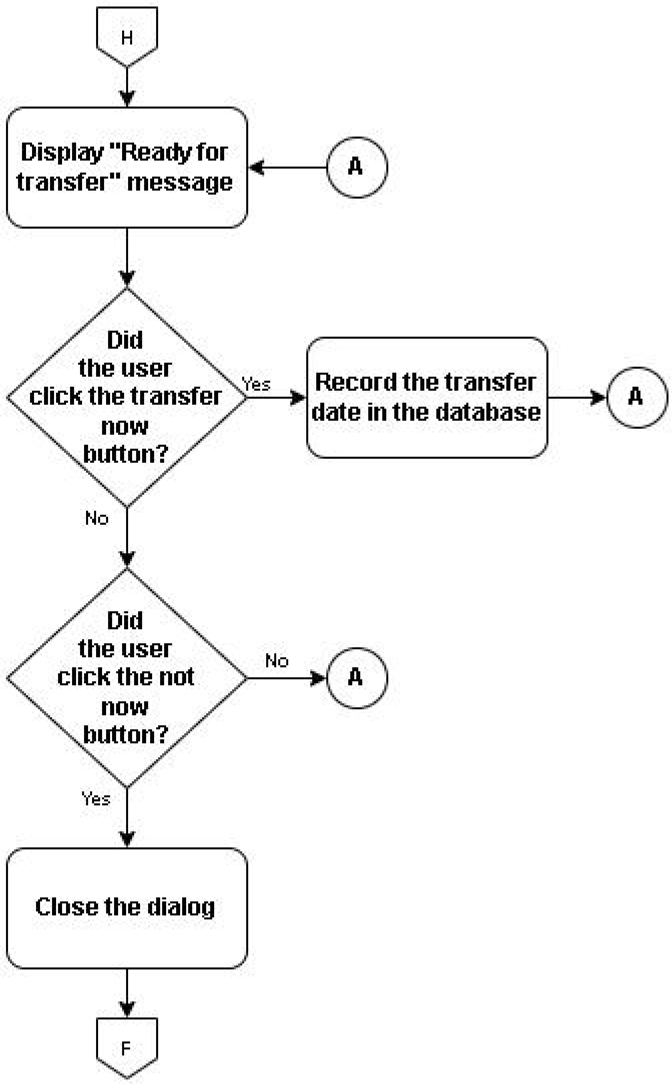

C
Display Dashboard Page
A
Did the user swipe right?
Yes
Display Camera stream
A
No
Did the user click Water monitoring module?
Yes
I
No
Did the user click Controls module?
Yes
Display Controls Page
A
No
Did the user click History module?
Yes
Display data History Page
A
No
Did the user click Maintenance module?
Yes
D
No
Did the user click Harvest module?
Yes
E
No
Did the user click Rejects module?
Yes
Display Rejects Page
A
No
Did the user click Plant monitoring module?
Yes
H
No
A

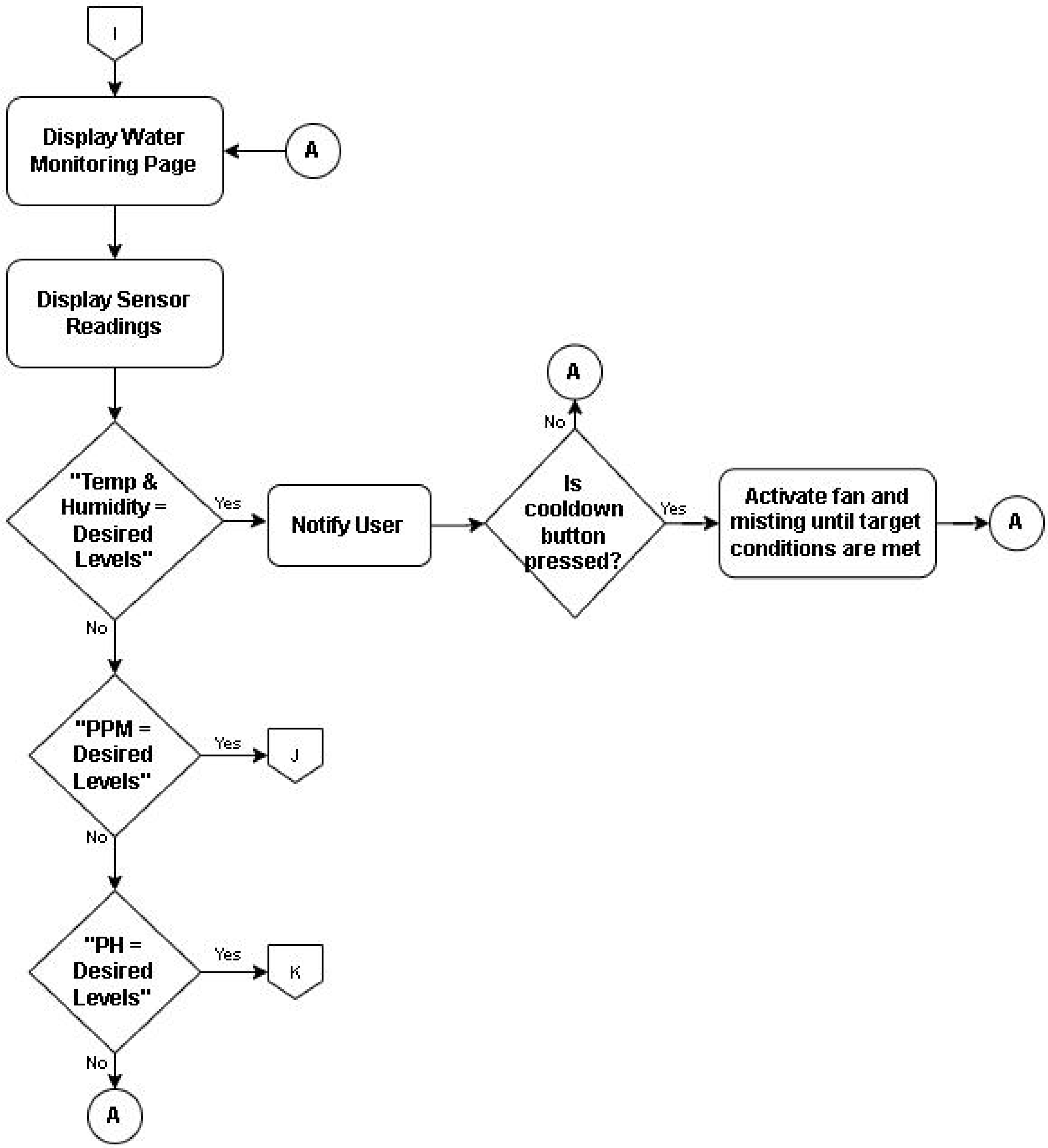

D
Display Maintenance Page
A
Did the user click the add icon?
Yes
Display dialog Maintenance options
Did the user click on options?
No
A
Yes
Store Maintenance Log
A
No
Did the user click the arrow down icon?
Yes
Display Maintenance Log
A
No
A

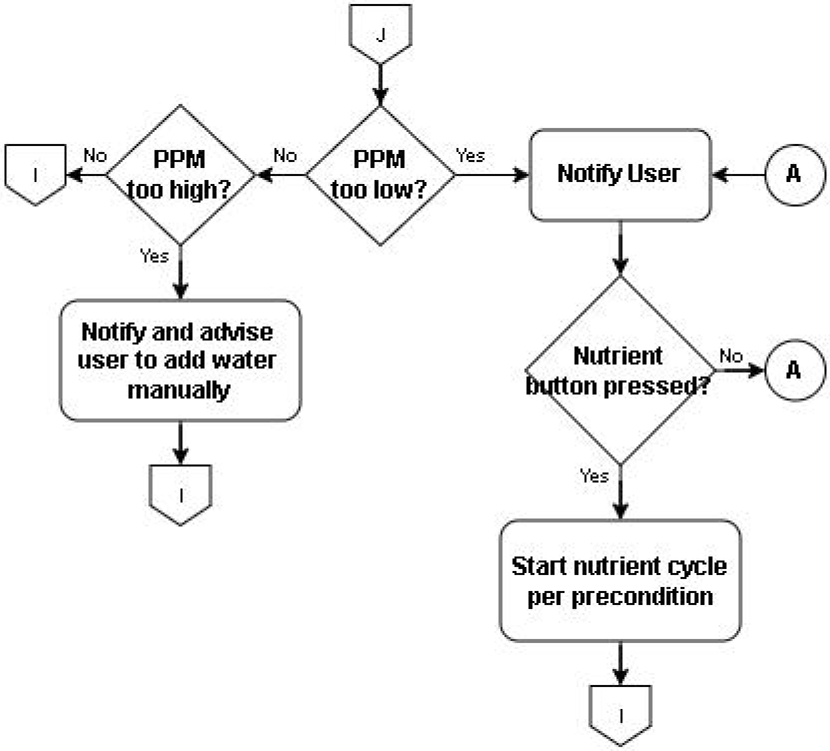

E
Display Harvest Page
A
Did the user click the summary?
Yes
Display the corresponding data
A
No
B
B
No
Did the user add new accepted harvest?
Yes
Number of accepted harvest
Did the user click submit?
Yes
Store in the database
A
No
Did the user add new rejected harvest?
Yes
Number and reason of rejected harvest
Did the user click submit?
Yes
Store in the database
A
No
No
A
B
B

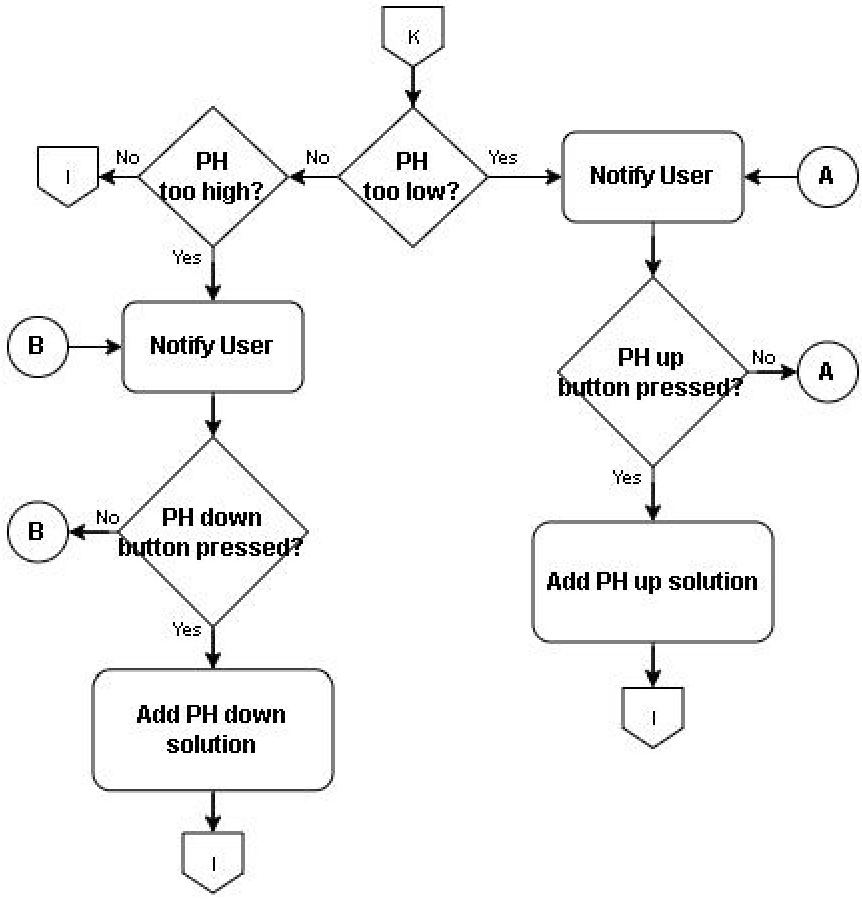

F
Display Plant Monitoring Page
A
Did the user click the growth tracker?
Yes
Display Plant timeline page
A
No
Did the user click the plant view?
Yes
Display live camera view
A
No
Did the user click the plant status?
Yes
Display Plant status
A
No
Did the user click the add new seedling?
Yes
G
No
Is there a seedling ready to be harvested?
Yes
H
No
END


G
Display Dialog for adding new seedling
A
Did the user filled out need inputs?
No
Display error message
A
Yes
Record seedling in the database
Display success message
F

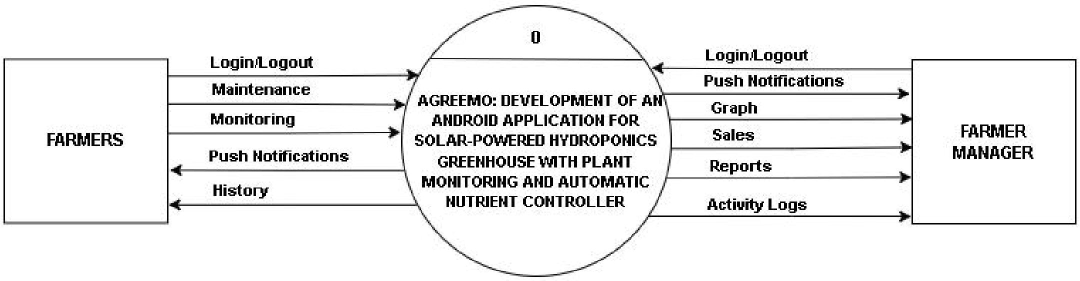

H
Display "Ready for transfer" message
A
Did the user click the transfer now button?
Yes
Record the transfer date in the database
A
No
Did the user click the not now button?
No
A
Yes
Close the dialog
F


I
Display Water Monitoring Page
A
Display Sensor Readings
A
No
"Temp & Humidity = Desired Levels"
Yes
Notify User
Is cooldown button pressed?
Yes
Activate fan and misting until target conditions are met
A
No
"PPM = Desired Levels"
Yes
J
No
"PH = Desired Levels"
Yes
K
No
A


J
PPM
too low?
Yes
No
Notify User
A
PPM
too high?
No
I
Yes
Notify and advise user to add water manually
I
Nutrient
button pressed?
No
A
Yes
Start nutrient cycle per precondition
I

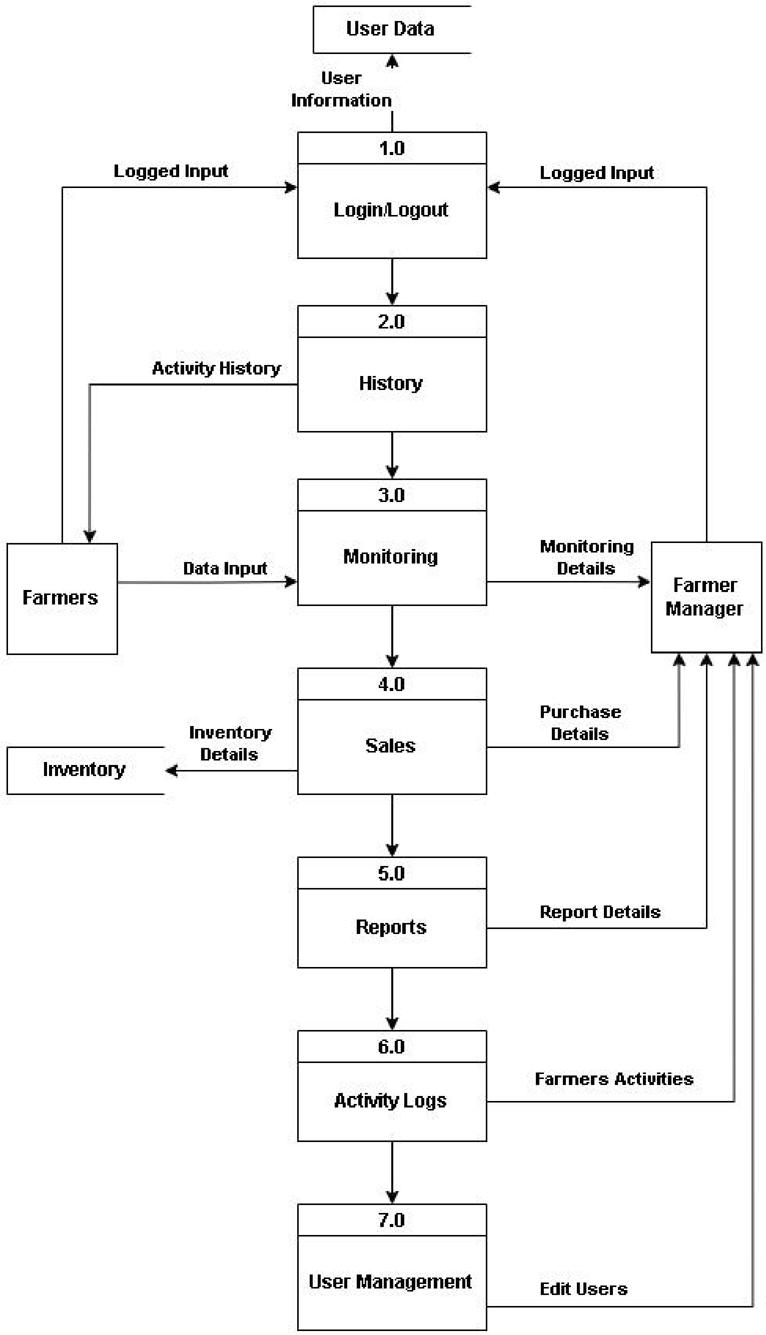

K
PH too low?
Yes
No
Notify User
A
PH too high?
No
I
Yes
B
Notify User
PH up button pressed?
No
A
Yes
Add PH up solution
I
PH down button pressed?
No
B
Yes
Add PH down solution
I

Context Diagram

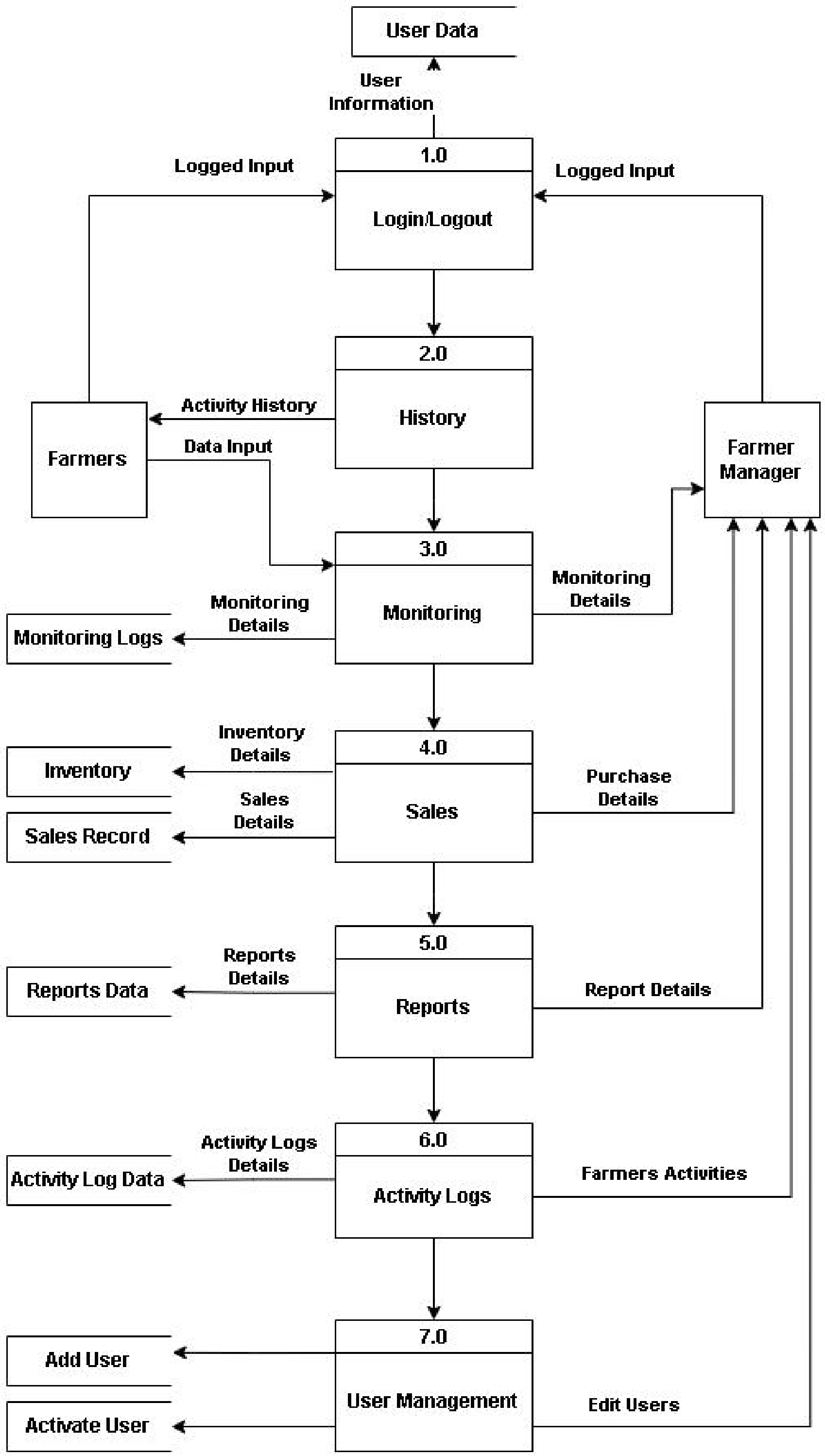


Data Flow Diagram

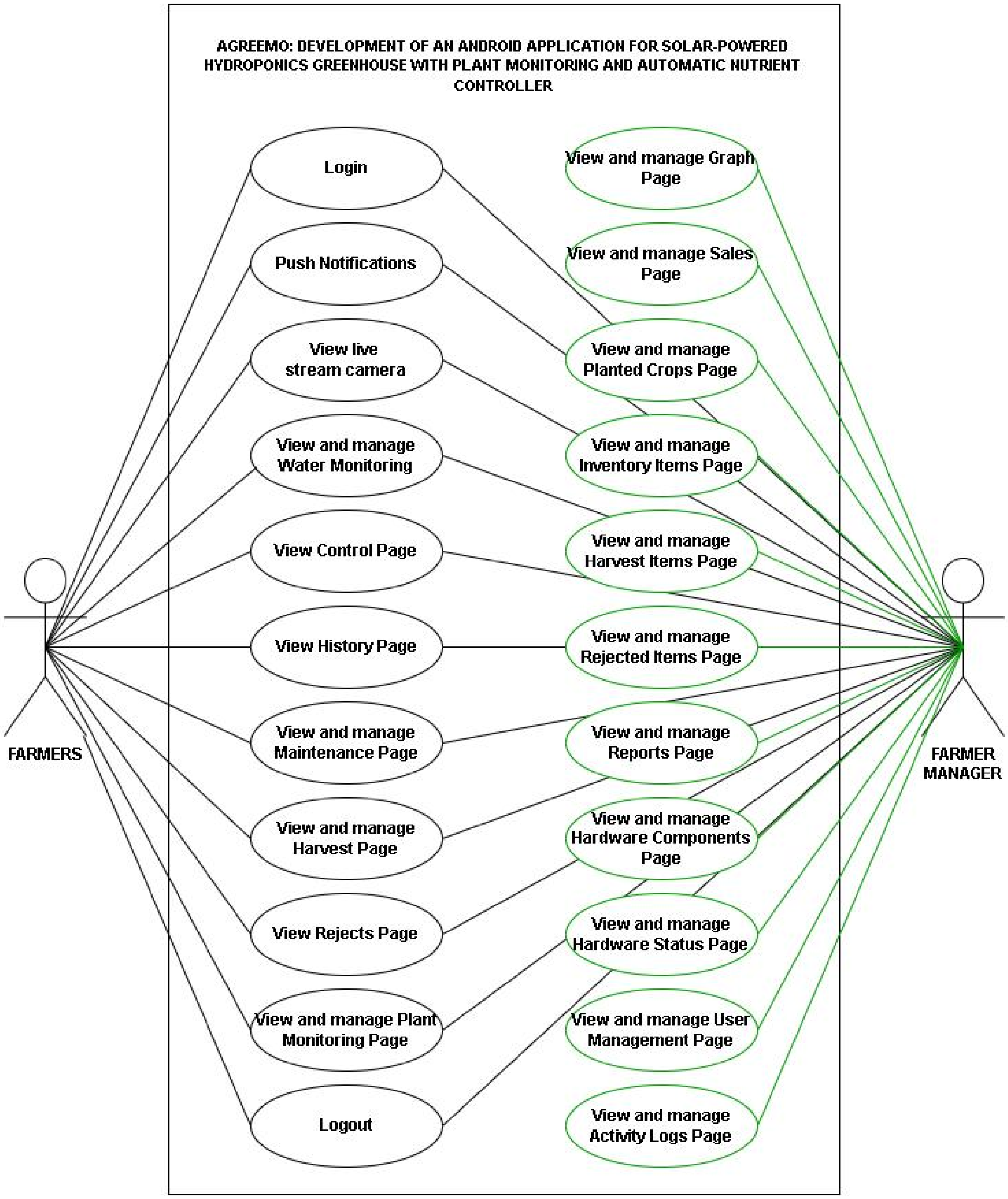
Level 1



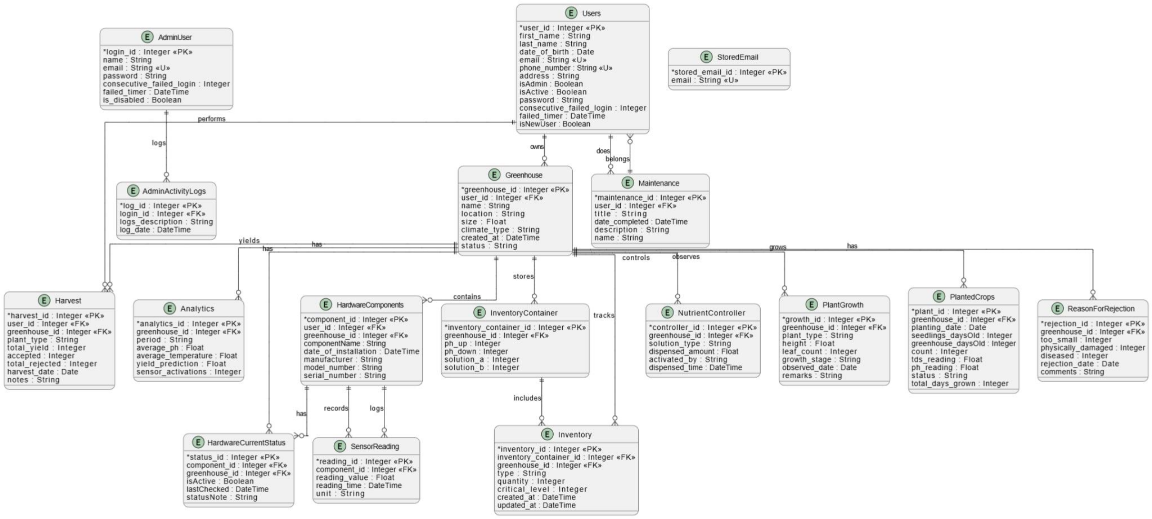
Level 2


User Data
User Information
1.0
Login/Logout
Logged Input
Logged Input
2.0
History
Activity History
Data Input
Farmers
Farmer Manager
3.0
Monitoring
Monitoring Details
Monitoring Details
Monitoring Logs
4.0
Sales
Inventory Details
Inventory
Sales Details
Sales Record
Purchase Details
5.0
Reports
Reports Details
Reports Data
Report Details
6.0
Activity Logs
Activity Logs Details
Activity Log Data
Farmers Activities
7.0
User Management
Add User
Activate User
Edit Users

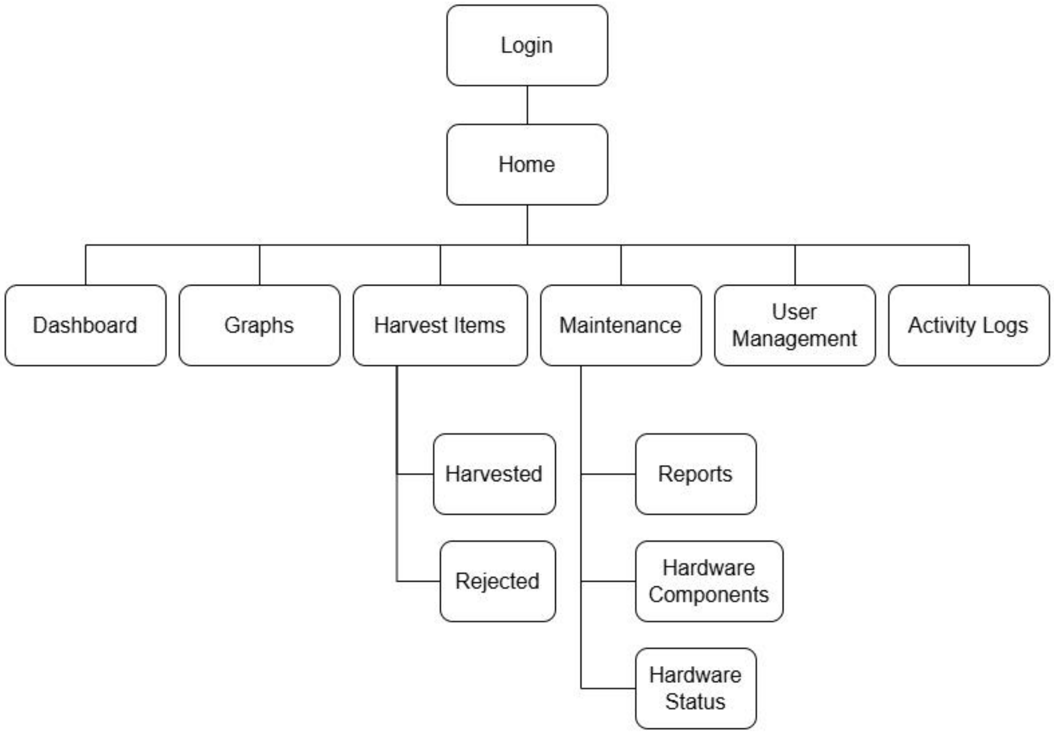
Use Case Diagram



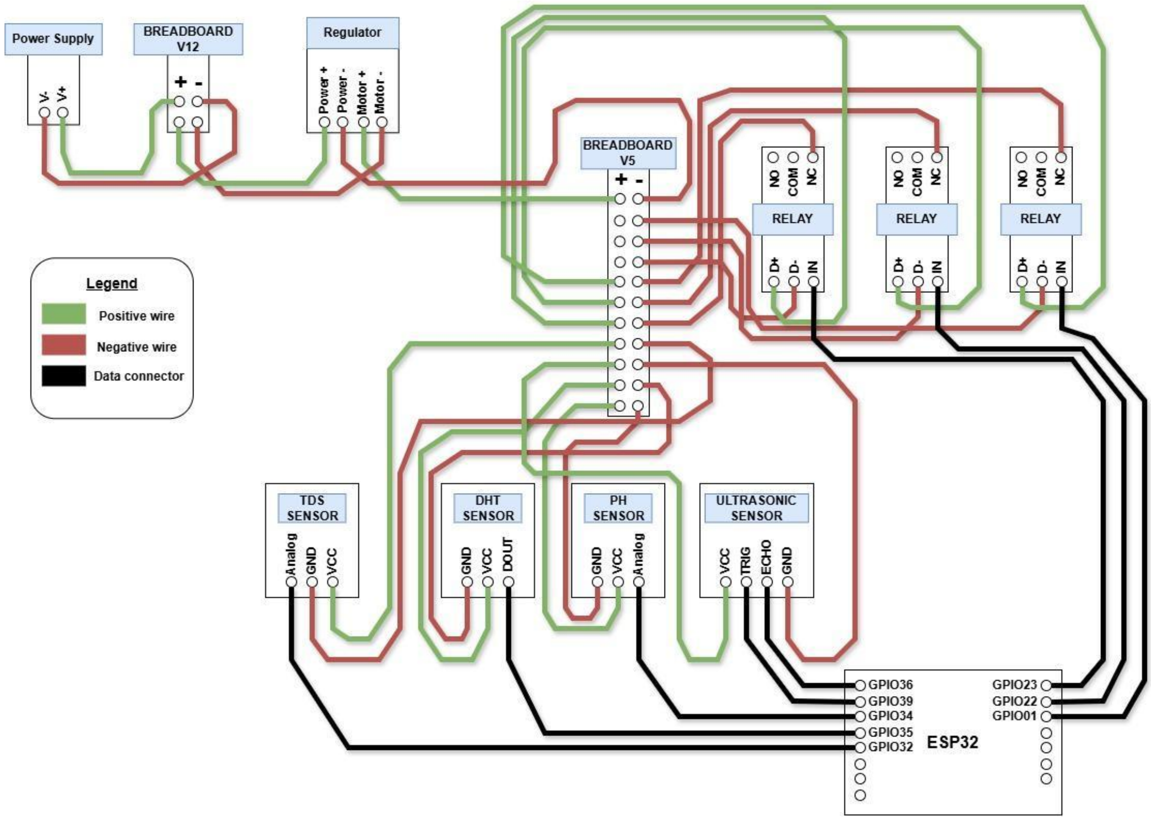
Entity Relationship Diagram



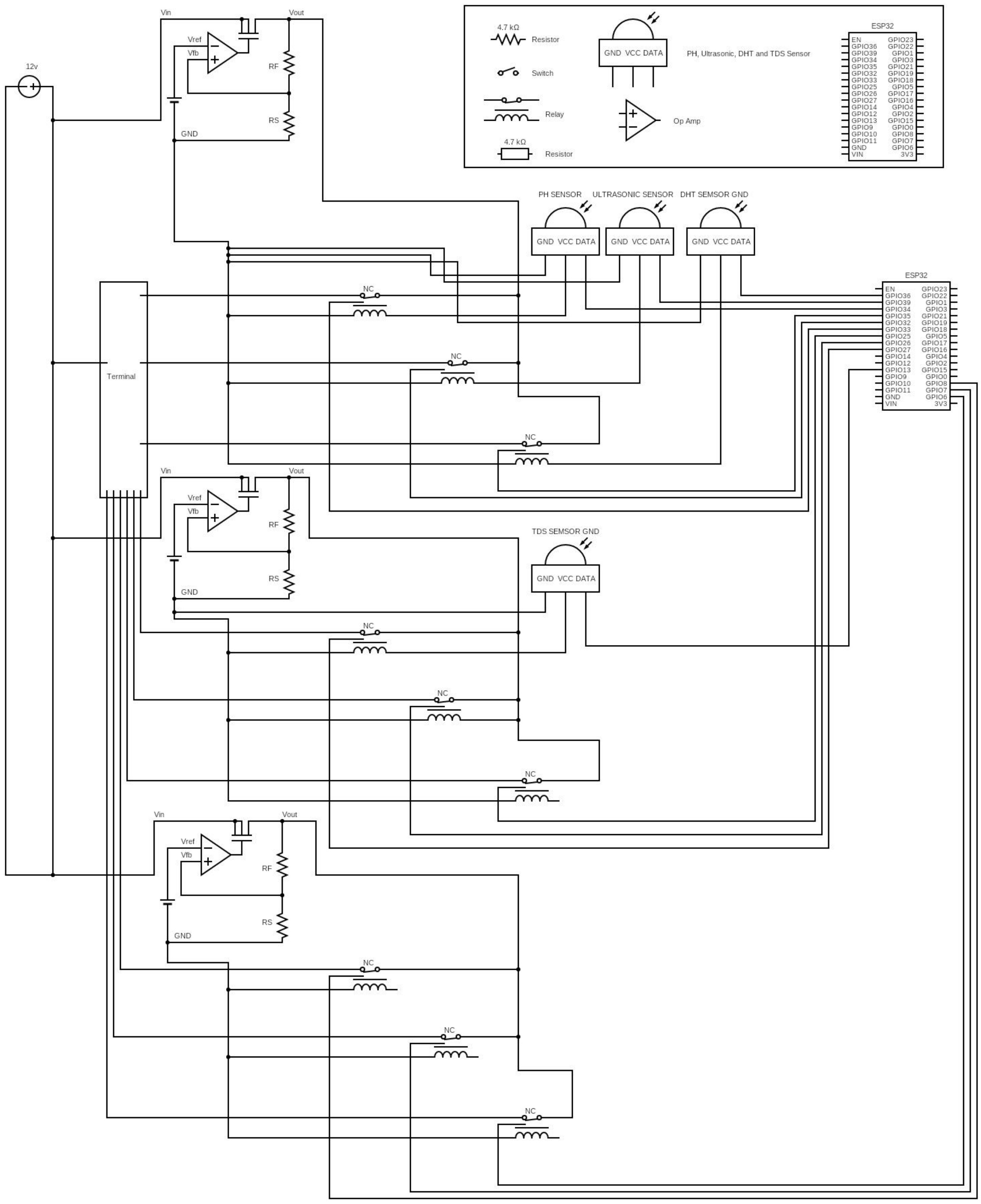
Site Map


Login
Home
Dashboard
Graphs
Harvest Items
Maintenance
User Management
Activity Logs
Harvested
Rejected
Reports
Hardware Components
Hardware Status

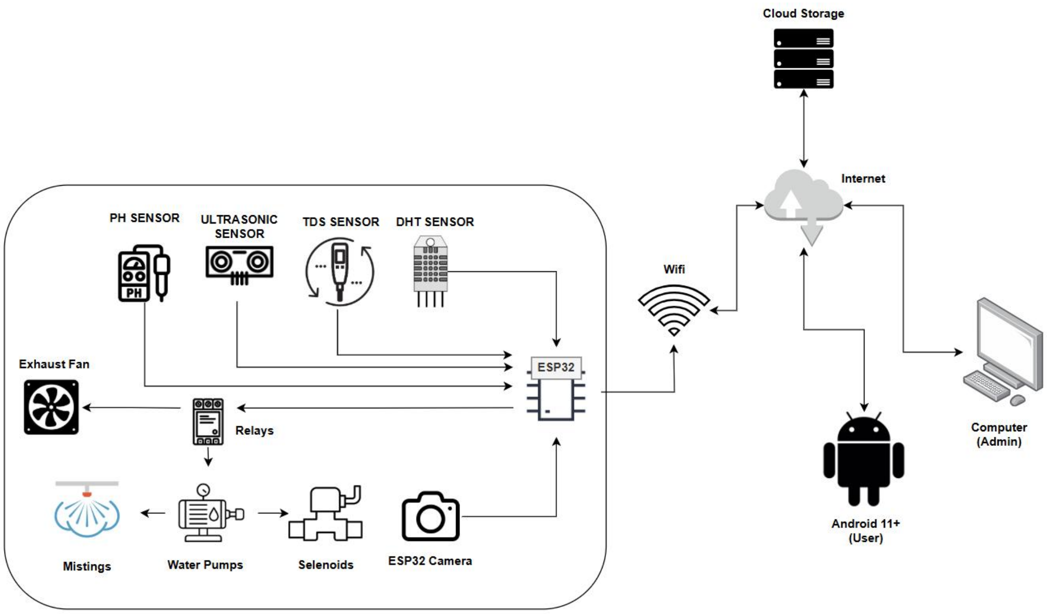
Schematic Diagram



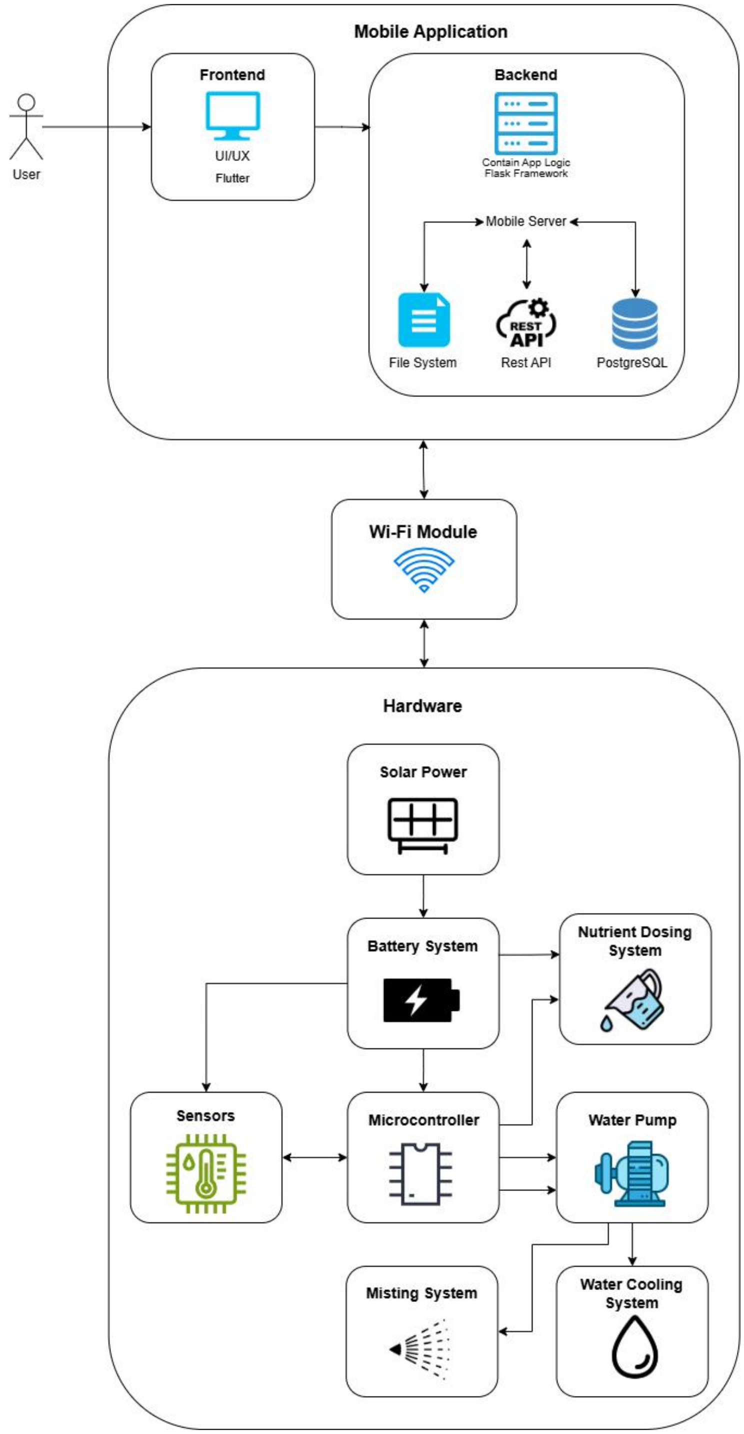
Circuit Diagram



Network Layout



System Architecture



APPENDIX F

Letter to the Company

QUEZON CITY UNIVERSITY
COLLEGE OF COMPUTER STUDIES
Information Technology Department

October 15, 2024

Hon. MARIA JOSEFINA G. BELMONTE
City Mayor
Quezon City Government
Elliptical Road, Barangay Diliman Central, Quezon City

Dear Hon. Belmonte:

The 4th year students of the program Bachelor of Science in Information Technology are required to conduct a research study and capstone project. The Capstone Project that they will develop should be based on their observed problem/s and gathered information from their research locale.

A Capstone Project Group chose your company as one of the stakeholders to their plan, our students are excited to work with your company, and allowing them to observe and gather the needed data for the completion of the project is a big help.

Allow us to provide you the possible activities the Capstone group shall exercise.

- The observation, interview and distribution of questionnaire for gathering data of Capstone Project Research 1 and 2 group will start upon your permission.
- The group should communicate and set appointments every time that they need your company data and information.
- The group is required to add their activities with your company in the project Gantt Chart.
- Confidentiality and ethics are already oriented to the students but help us remind them about security measures on accessing data and documents from your company.

Your company's contributions to our students' explorations and experiences in conducting research and developing capstone projects will be appreciated. If there are matters that you want me to discuss with you, please contact me thru this number 09616049255.

Thank you for your kind consideration.

Sincerely yours,

Julito Tiro III
Project Manager

Noted by:

Norilyn Sindanum, MAIE
Subject Adviser, Capstone Project and Research 1
Quezon City University

RECEIVED
DATE 10-18-24
CONTROL NO: A1Qu-27539
RECEIVED BY Elsie
TRUNKLINE: 988-4242

QUEZON CITY UNIVERSITY
COLLEGE OF COMPUTER STUDIES
Information Technology Department

February 28, 2025

QCU's Farmer
Quezon City University
673 Quirino Highway, San Bartolome Novaliches, Quezon City

To QCU's Farmers:

The 4th-year students of the Bachelor of Science in Information Technology program are currently working on their capstone project, which involves developing the AGREEMO system—an Android Application for a Solar-Powered Hydroponics Greenhouse with Plant Monitoring and Automatic Nutrient Controller.

One of our Capstone Project Groups has identified your expertise and experience as valuable for evaluating the system. We kindly request your permission to allow the students to present and have the system evaluated by you. Your feedback will be instrumental in refining the app and ensuring its effectiveness.

The evaluation will involve observing the system, providing feedback, and completing questionnaires. All activities will be tracked in their project Gantt Chart.

Please note that confidentiality and ethics have been emphasized with the students, but we ask for your support in reminding them about security measures when handling any sensitive data during the evaluation process.

We greatly appreciate your help in providing our students with this opportunity to gain feedback from professionals in the field. If you have any questions or need additional information, please feel free to contact me at 09616049255.

Thank you for your kind consideration.

Sincerely yours,

Julito Tiro III
Project Manager

Received by:

Noted by:

Norilyn Sindanum
Subject Adviser, Capstone Project and Research 1
Quezon City University

APPENDIX G

Transcript of Interview

Simplicity Greenhouse Interview

Jayboy and Giebert Interview

Jayboy – Ano po position nyo?

Farm Manager - Farm Manager

Jayboy – Pano nyo po minamanage yung greenhouses?

Farm Manager – Bale yung gamit namin ngayon ay automated sya kumbaga may timer kami tapos, pwede mo rin syang I manual para kung sakaling may ita-try ka. Tapos meron kaming mga meter para sila na yung nagreread ng PC tyaka PH level naming. Tapos dun naman sa cooling system ginagamit namin yon pag mainit sa loob. So aakyat yung tubig don sa taas.

Jayboy – Most likely maam anong plan po yung kailangan ng cooling system? Lahat po?

Farm Manager – Yes po.

Giebert – So required siya talaga na may cooling po?

Farm Manager – Oo, pero minsan yung mga gantong panahon hindi ko na ino-on. Kasi malakas rin sa kuryente.

Giebert – Ah so manual yung pag turn off nyo po?

Farm Manager - Opo manual, Hindi pa talaga kami automatic na kapag nag raread siya kung mainit na, mag o-on.

Jayboy – What are the challenges you have face in insuring the sustainability?

Farm Manager - Weekly cleaning talaga ng lahat ng materials kasi kapag hindi naming nagawa yon pwede kami pasukin ng peste or disease. Halimbawa, pag kasi isa dyan nagkaroon ng root rot eh iisa ang reserve mo na tank na ginagamit namin so lahat na yon affected.

Jayboy – So yung challenges nyo pala rito is contamination pala.

Farm Manager - Oo.

Jayboy – How do you ensure the scalability of the greenhouse system to accommodate, Parang ano maam yung may ginagamit po kayong solution.

Farm Manager - Yung mga nutrients. Bale gumagamit kami ng npk, ions, calcium at magnesium. Ayon talaga yung parang feeds ng letus kumbaga kung tubig lang gagamitin naming hindi sila lalaki. Yung ions kasi additional yan pag nakikita mo na medyo naninilaw na yung mga plants, aadd ka lang ion.

Giebert - May specific detection kayo for that po?

Farm Manager - Wala pa po, So tinitignan ko lang siya talaga sa itsura ng lettuce. So pag ayan lahat na nanilaw dapat mag apply na ng ion para sa mga susunod na araw ay babalik siya sa kulay nya. Siguro mga 3 days mapapansin yung changes.

Jayboy – Manually po? Tinitgnan nyo po talaga mismo?

Farm Manager – Kasi diba large scale kami so makikita mo agad eh na yellowish na.

Jayboy – May mga technology po kayo na ginagamit?

Farm Manager – Yung sa pump lang na automatic siya nag oon dahil sa timer yon tyaka doon sa ph level na meter naming.

Giebert - Pano nyo po nadedetect yung ph level?

Farm Manager – Bale meron syang ano nakaano siya sa tubig tapos meron siyang reader doon naming tinitignan, yung bluelab.

Jayboy – Hindi po kayo gumagamit ng solar?

Farm Manager – Wala pa pero ang alam ko magkakaron kasi nag request kami sa DOST ng battery kaso hindi kami na approve. Dapat iautomate nila yan.

Jayboy – Eto po maam sa water recycling, pano niyo po pinapanatiling malinis yung tubig?

Farm Manager – Bale weekly kasi nag to-top up ako, ayon yung term namin kapag nauubos na ng lettuce yung water. So top up tapos 1 month deep clean kami. As in pressure washer lahat ng sides.

Giebert – Tapos yung container po ng water, automatic po ba nag fi-fill up? Or manual po?

Farm Manager – Manual parin nagbubukas parin ng gripo, may pump lang.

Jayboy – May filtration po kayo na ginagamit dito?

Farm Manager – Ano lang pag yung tubig ulan ang gamit tapos may net lang doon para i-filter yung mga alikabok. Tapos pag wala naman kaming rain water, ifi-fill up ko yung tank ko one day before ako mag timpla para yung chlorine nakasingaw na kasi nakakaapekto iyon sa halaman.

Jayboy – Pano nyo po pinapanatili maayos yung water pump nyo? Nililinisan niyo rin ba?

Farm Manager – Oo, checking din siguro mga once every 6 months kasi everyday sya gumagana eh, every hour so kailangan niya talaga ng maintenance.

Jayboy – Gumagamit po kayo ng net dba maam so okay na po ba yon sa pag filter ng rain water?

Farm Manager – So far okay naman po na hindi na naming siya lagyan ng kung ano ano. Okay na na rainwater tapos deretso siya sa reserba ko tapos titimplahan ko lang.

Jayboy – So ginagamit niyo po yung rain water tapos deretso na sa solution.

Farm Manager – Oo solution na kami agad.

Jayboy- May mga soil base po ba kayo?

Farm Manager- Wala talagang hydrophonics kami, ang gamit po talaga is soil less

Jayboy- Buti maam hindi po kayo nag aerophonics

Farm Manager- Hindi pa, medyo mahal kasi aero

Jayboy- May heater po ba kayong ginagamit?

Farm Manager- Wala e

Jayboy- Maam what are the best strategy for maintaining the temperature?

Farm Manager- Ang ginagawa ko lang sir, ang inadjust naming roofing talaga ng greenhouse so mas mataas mas mababa yung chance na makukulob yung init sa loob so nag add pa kami ng cooling system

Jayboy- May cooling system kayo maam?

Farm Manager- Oo meron at chiller, bale bumili ng chiller tapos cinonnect namin sa water tank so kapag mainit, summer malamig yung tubig naming

Jayboy- Yun ma'am yung mga challenges po sa temperature

Farm Manager- Sa summer lang talaga, so pag nag spike na yung 40 na yan wala na kaming magawa kundi ang iadjust lang yung chiller para kahit papano mainit man sa loob yung tubig na papasok sa ugat malamig pa rin.

Farm Manager- Sa tag ulan naman ang challenge naming kasi kailangan namin ng araw, di lalaki ang lettuce kung walang araw

Jayboy- Pag sa summer maam, ano yung minimaintain niyo sa loob para mapalamig yung tubig

Farm Manager- yung sa chiller kailangan ko lang i-on yun

Jayboy- Chiller lang po ba meron kayo?

Farm Manager- tsaka yung cooling system magkaiba kasi silang dalawa

Giebert- Ano po yung cooling system?

Farm Manager- Yung sa cooling system yun yung umaangat yung tubig tapos nag cicirculate kung mainit ba yung sa tubig papalamigin naman yun ng fan na umiikot

Jayboy- Yung sa pest maam manually din po ba?

Farm Manager- Yes manually din

Giebert- Paano niyo po napeprevent yung pest po doon?

Farm Manager- Hindi kami nag iispray ng pesticides ng mga chemical so umaasa kami sa organic

Jayboy- Anong organic po?

Farm Manager- Yung Castille Oil and Neem Oil yan lang talaga gamit naming

Jayboy- For pest po ito maam?

Farm Manager- Yes po

Sunnyville Farm Interview

Leomar: Tanongin ko lang po muna ano po yung mga greenhouse na ginagamit niyo po

Sally: Ang greenhouse nagtatanim din kami sa loob kaya lang walang hangin yan eh

L: Walang hangin

S: Mainit talaga yan

L: Ask ko lang din po ano po pangalan Ninyo

S: Ako si Sally Cruz retired FAD personnel

L: Ano po posisyon niyo po dito

S: Volunteer lang ako dito just to have ano- exercise nagrerender lang ako dito atleast 2 – 3 hours a day

L: Sa pagtatanim niyo po ano po kadalasan niyong tinatanim dito

S: Ano variety dito eh sa ngayon tag ulan nagtanim ako banda doon dito naman sa greenhouse kangkong tinanim ko dyan dito naman okra at tsaka kangkong gawa ng tag ulan

L: Yun po yung usually niyong tinatanim dito kangkong

S: Kangkong, petchay

L: Kangkong at petchay

S: Mustasa, saluyot, okra

L: Mga gulay po talaga

S: Green leaf karamihan, talong

L: Ano po yung mga tanim niyo na mabilis tumubo

S: Ang mabilis Kangkong tapos petchay kasi ang petchay within a month harvest ka na ganun din yun saluyot

L: Saan niyo po tinatanim yung talong petchay niyo po

S: Sa mga hardin din naming kinucultivate din namin, meron din dyan, meron din sa labas

L: Kahit saan po siya pwedeng tumubo

S: Kaya lang ang ginagawa namin hindi pwede na sa isang greenhouse iisa lang itatanim mong klase

L: Ah may variety

S: Variety talaga

L: Kase kung nagpeste yung isa safe padin yung kasunod niya kasi hindi niya kapareha yun yung advantage nun

L: Dapat magkakaiba sa loob ng greenhouse

S: Kahit isa lang na lugar hindi parepareho para masave sila kahit mapeste save parin yung katabi niya kasi hindi kapareho

L: Ikaw meron ka bang question

Tiro: Ako nga pala po si Julito Tiro ma’am ako po yung project manager ng group, tanong ko lang ma’am curious lang din may pagkakaiba po ba ang tinanim natin sa greenhouse compare sa tinanim natin sa labas

S: Meron kapag ganitong tag ulan

T: So usually po kapag normal days

S: Pag normal na mainit Maganda sa labas

T: Maganda parin sa labas

S: Kasi may sunshine

T: More on may protection siya sa ulan

S: Yan kasi protected sila sa ulan kahit umuulan nagdidilig parin kami kasi mababasa man lang sa gilid lang hindi makuha sa gitna

T: Ah so yun po yung difference po

T: How about naman po sa operation niyo po ano po yung mabilis ihandle or I maintain yung greenhouse po natin or yung mga nasa labas

S: Pareho lang eh

T: Almost the same lang po?

S: Ang greenhouse kailangan mo rin maintain sa labas imaintain mo rin kasi ang kalaban mo pag ganito tag ulan damo pag tag init naman tubig ang hirap ng tubig

T: So ibig sabihin po mas safe po yung sa greenhouse since kunyare pag umuulan po syempre pag bagyo or maraming ganyan how about po sa mga insects or peste particular po dun nakakatulong po ba ang greenhouse dun

S: Pag pest naman oo nakakatulong kasi hindi nakakapasok mga peste

T: Pano naman po pag mainit sa greenhouse pano niyo po namamaintain yung temperature ng greenhouse

S: Normal na yun eh kasi pag ganyang tag init mainit talaga dyan sa loob kaya lang safe sila sa pest kasi nakasara

S: Sa loob po ng greenhouse

S: Oo para kang nasa oven pag ikaw nag tatanim dyan kaya kailangan umaga at hapon ka rin magdilig kapag ganyan tag init kasi mainit

T: So kailangan po pag taginit po mas frequent dapat po yung pag dilig pag nasa greenhouse

S: Oo kasi natutuyo

T: Any particular po na ginagamit niyo po sa pagdidilig po para makaano siya or talagang tap water lang

L: Ano po yung tubig na ginagamit niyo

S: Ang ginagamit naming tubig dito nag ano kami nag hukay ng balon balon yun yung kinukuha naming pandilig kasi organic kami

T: Wala na po kayong nilalagay dun sa tubig or what

S: Wala kasi yung soil namin organic combination ng lupa, manure rabbit, manure ng baka, kalabaw ganyan tapos rice hull, tapos carbonated yun pag combinin namin yun lang pinakafertilizer niya kaya very safe ito kasi organic hindi kagaya sa labas karamihan ginagamit ay ano na yung chemical

T: Napansin ko po dyan sa greenhouse niyo meron po kayo parang sprouter

S: Dati

T: Working pa po ba yan

S: Sa tingin ko hindi na eh, hindi na naming ginagamit

T: So meaning po ang pagdidilig po ninyo manual po talaga

S: Manual, Oo kaya nga ang bawat isang plot isa ang may hawak o dalawa

T: Usually so matagal po pero naexperience niyo po ba gamitin po ba yan yung sprinkler

S: Mula ng pumasok ako dito hindi ko nagamit

T: So more or less po talaga puro manual po halos talaga

L: gumagamit din po ba kayo ng rain water sa pag dilig niyo po

S: Oo pag meron

L: Kinocollecta niyo po ba yung rain water

S: Hindi

L: Hindi na po, deretso na sa greenhouse

S: Tsaka ano may mga balon kasi kami pumapasok naman dun ang rain

L: Ahh may balon po kayo dun niyo po kinokolekta yung rain water

S: Oo

L : Kailangan po ba, May mga process po ba malinis yung rain water ninyo

S: Hindi naman necessary

L: hindi na po siya necessary deretsong buhos na sa mga plants po ninyo kapag naipon na

S: Hindi na, kasi organic lang naman yung aming gamit eh

L: okay po

T: Ma'am kasi yung ano po particular po kasi sa project namin mga IT student po kasi kami parang ang gusto po kasi naming i-incorporate po namin yung technology particularly po sa process po ninyo usually yung mga manual process po ninyo pwede na po siyang iautomate like yung sabi niyo po yung particular po namin yung sprouter pwede po naming yung pag dilig po pwede po namin I sprinker pwede po nating gamitin yan pang automation na

S: Oo pag automation pwede kasi gusto mo mag dilig buksan mo lang yung faucet mag shshower na siya

T: Yes opo napakaconvenient even sa bahay po pag nagshshower di ba, yun po yung ano namin pinaka ano namin plus kasi syempre rin po yung malaman din namin yung condition ng lupa pwede nating ma- ano po ba usually way ninyo para ma-check ano po yun eye test nalang po ba yun para malaman niyo yung condition

S: Hindi, kasi di ba dapat dadaan sa quality control ng lupa wala kami noon eh, kaya ang ginagawa namin minsan nagagawa kami ng ano, tawag dito, yan, hindi quality control yan yan ang ginagawa naming bukasi yung mga-

T: Ahhh parang composite po

S: Oo parang composite, nag cocomposer kami yung mga dahon dahon at meron din kaming ano yung madre de cacao yun organic yun na ano

T: so parang yun yung ginagamit niyo para masustain yung greenhouse

S: Greenhouse, Tsaka meron din kasi kaming ano dyan eh fish amino acid, para pang ano sa tanim namin pang tibay ng ugat tsaka pang pa green ng dahon

L: Ahh fish amino acid

S: Ano siya yung bituka ng isda yun ang inaano namin

L: Paano niyo po siya nilalagay

S: Ayan yun siya yung- bituka ng isda hasa ng isda tapos nilalagyan namin ng-

L: Tubig- Molasses

S: Molasses, oo molasses

L: Tapos nilalagay niyo po sa tanim niyo na po

S: Oo, One is to one yun eh isang litro isang kutsara

L: Kutsara po

S: Kutsara ba ano tablespoon

L: Tapos ilalagay sa

S: Litrong tubig tapos yun yung dinidilig sa puno hindi siya sa dahon kasi pag sa dahon namamatay siya eh

T: Ma'am particular po sa greenhouse po ma'am ano po yung mga electric powered po niyo dyan

S: Hindi na gumagamit

T: Halos wala na ginagamit

S: Manual eh

L : Puro manual po

S: Kasi pag mag tatanim kami bubungkalin namin ulit lalagyan mo nanaman ng ano ng pataba

T: Ibig sabihin po pag wala pong kuryente po dito okay lang po kayo dito pag ano, walang problema

S: Walang problema ang nangangailangan lang ng kuryente ay itong ano fish pond

L: Fish pond niyo po

S: Kasi meron silang meter yan eh, pero pag manual pwede lang yan

T: Okay any other question

L: So pag tatanim niyo po ma'am pano niyo po nalalaman kung harvestable na yung kunware po yung kangkong niyo po yung talong

S: May ano certain height

L: certain height po kayo na finofollow

S: Oo kasi pag nakadalawang dangkal na Malaki na yun eh harvest na

L: harvestable na po siya

S: Pero ang kangkong minsan 4 – 5 times every 3 weeks

L: Paano niyo po nalalman na yung plant na tinanim niyo po is hindi po siya- tumutubo siya ng Mabuti

S: May taga gawa ng ano eh- sila ang naagseseeds itatanim lang namin, ready na parang yung mga yun, meron silang ano sariling- nagagawa sila ng seedlings yun kukunin namin yun ang aming itatanim

L: Any more questions

T: If ever ma'am na mag integrate tayo po ng technology dito sa processo niyo po dito okay lang po ba sa inyo yun or open po ba kayo sa ganun?

S: Ay depende sa aming boss kung ano kasi kami ano lang kami eh volunteer lang kami dito

T: Actually kasi yun kasi yung gusto namin I ano I propose yung mga manual process po ninyo like yung for example yung mga irrigation po ninyo

L : Pag didilig po

T: Pwede po nating I automate yun then pwede tayong gumamit ng renewable energy for example po yung solar energy para mapowered po yun para incase mawalan ng kuryente po dito para masustain din

S: Gaya ng sa aming isda solar, solar yan

T: Yun nga actually yung gusto po naming gawin then yung greenhouse natin pwede natin i-solar powered

S: Pwede rin

Alam dapat ni manager namin

Manager lang namin ang makapagdecide niyan

T: Yes po, Atleast po para masabi ko po sa inyo para mavisualize din po ninyo yung gagawin namin

S: Di kami pwede mag ano

T: Even po yung ano natin even po yung tubig ulan po natin pwede rin po nating iharvest

S: Pwede po gaya ng sa greenhouse yung sa alulod niyan

T: Yes nga po ang balak namin yung lahat ng maano po dun pwede natin maharvest po siya and then-

S: Maiano sa drum

T: Malagay sa drum and then pwede nating gamitin yun para pang

S: Ako ginagawa ko sa 3rd floor ko kasi may halaman din ako

T: Oh di ba Maganda po

S: Lagyan ko ng ano wala nga alulod eh sa may ano lang niya ihilera ko lang yung mga balde

L: Iipunin niyo po yung tubig

S: Oo, makakalibre ka man lang ng tubig ang mahal mahal ng tubig

Marami rin kasi yang pandilig namin yan eh pag mag palit kami ng tubig sa isda katulad po kasi may mga alaga kaming isda, tilapia so kapag may nagpapalit ng tubig ng tilapia so di kami nag sasayang ng tubig ang ginagamit po niyan sa pandilig po namin yan ng halaman siya ang iniipon po namin pang halaman is pinandidilig namin kasi bilang fertilizer din kasi ng pupu ng mga isda

T & L: Yes po

S: Oo yun kaya organic po ang ginagamit po namin dito hindi kami gumagamit ng kung anong chemicals tapos tungkol sa pag gawa namin ng fertilizer tulad po ng di ba yun mga puno na may damo damo hindi po namin yan tinatapon kundi tinatabi namin sa isang tabi para siya ay mabulok at yun po ang gagamitin namin para sa plants namin ginagawa namin parang manure hinahaluan ng tae tapos ginagawa namin siyang compost kapag compost na siya yun ang nakakalambot sa lupa nagiging buhaghag ang ating lupa kaya Maganda ang ating tanim ang labas ng ating tanim

T : Ma'am kailangan pa po ba salain yung tubig dyan pag nagdidilig po?

S: Hindi na po kailangan

L: Deretso na po siya?

S: Oo, deretso na po siya kasi isa na pong fertilizer po yung pupu ng isda

T: Pero kasi po kung gagamitin natin siya pang sprouter kasi dun baka bumara yun

S: Babara yun, pag nawasa oo

Syempre pasisingawin natin yun kasi may chlorine yun eh

T: Ah hindi rin po pwede pero kung dito po natin yan kung padadaanin po natin sa greenhouse natin basta pwede ba nating salain nalang po ba yun

S: Kagaya rin ng sa loob sa greenhouse na yan may tanke yan sa taas eh yang greenhouse na yan meron yan sa taas yan eh

T: Saan po nangagaling yung tubig sa taas

S: Nawasa po yan

T: Ah nawasa

S: Oo pero kahit sa nawasa siya

T: Hindi niyo po muna

S: Oo nakasingaw

T : Nakasettle siya

S: Oo naka stock siya

Kasi may chemical kasi yang tubig yan eh

Mas Maganda po natin yung tubig ulan tapos gagamit ka ng tubig iipunin kasi pwede nating pandilig pwera lang yung may sabon

Kasi iba na yung may sabon

T: Tanong ko lang po yung sa fish pond niyo na tubig kumbaga sasalukin niyo po ba yung tubig

S: Merong ano

Merong hose

T: Ahh merong hose, so pwede pala yung gawin natin, so parang centralized na ano-

S: Sa halip na itatapon yung tubig di ba sayang tubig sa halip na itatapon yung tubig dun namin dun na namin dinadala sa mga halaman naming pandilig, kaya wala kaming nasasayang na tubig, pagkanagkukulang kami ng tubig na ipon so pumupunta kami sa mga balon balon namin

T: May times po ba na nangyayari po yun lalo na po siguro kapag summer

S: Wala naman pong nangyari na nagkulang kami ng tubig dito kasi may mga balon balon po eh pwede namin pagkunan

May mga bukal bukal dyan sa gilid gilid mahirap lang saluki

T: So parang masasabi po natin eto pong farm niyo rito medyo nasusustain naman po yung water ano-
L: Yung energy rin nila sustainable kasi may solar power

T : Ano tingin niyo po sa part dito na sa farm po ninyo na pwede natin iimprove para mas mapabilis po yung proseso yung sa part na nahihirapan

S: Sa interview nahihirapan

T: So ginagawa niyo po rito area area po kayo dito?

S: Oo

T: Pagandahan? Di naman

S: Di naman

T: I'm sure naman po marami naman pong nagiinterview sa inyo po dito

S: Oo may mga international

T: Atleast po kami local

S: Mas okay na local kasi mas naiintindihan namin

T: May particular po ba na tinatanim kayo sa greenhouse lang na hindi pwede sa ibang- sa labas or mga ganun

S: Wala parehas lang

S: Kaya lang pag nagtagulan prefer mo yung ano yung greenhouse kasi lalo na pag petchay ang nilagay mo pag sa labas patay dahil sa ulan nalulunod sila

T: Ibig sabihin ma'am may times po kunware depende po sa season depende rin po yung itatanim po ninyo

S: Yes

T: For example pag sunny po ano po yung mas malakas po pag bumenta

S: Pag sunny days kasi Maganda rin sa labas yung petchay, kangkong, okra, saluyot at tsaka yung mga katutubong gulay kasi iniintroduce na sa atin yung ano katutubo

T: Pag tagulan ma'am

S: Pag tagulan namamatay yung mga petchay sa labas

T: So ginagawa po ninyo-

L: Greenhouse

S: Sa greenhouse nilalagay

T: May times po ba na pag kunware biglang umulan or nag rainy season na itrtransfer niyo pa po ba

S: Hindi na hinahayaan nalang masira kasi ilipat mo man wala nang Pagasa na eh

T: So ibigsabihin po yung mga waste po ninyo halimbawa sabihin na nating naghaharvest po kayo di ba may mga yung parang mga reject may mga ganun po ba kayong naencounter oh hindi pala pwede ibenta to ganyan and then ano po yung ginagawa ninyo

S: Kami na po

T: Ah inuulam niyo na po

S: Fertelizer din, pag reject ibubukasi namin

L : Paano niyo po nalalaman na rejected po yung plant na ginawa niyo

S: Maliit, sira ang dahon hindi mo naman maavoid yun eh para hindi siya masayang ginagawa namin siyang fertilizer

T: Pero mas more or less mas marami parin naman yung nahaharvest niyo

S: Oo

L: Sa composting po paano niyo po namamanage, opo yung mixture nailalagay niyo po

S: Yung nilalagay ko dyan yung isda yung mga bulok-bulok na gulay, nipa yung ano ng bigas, sa Ilocano tuyo eh, yung kinakain ng manok ano nga yun, darak ayun, pabayaan na siya dyan hanggang sa mabulok magtutubig siya yun ang pang ano

T: Pero lahat po yan available dito or may binibili pa kayo

S: Wala dito lang

T: Lahat po?

S: Oo dito lang yung mga gulay, yung mga kangkong, meron kaming talbos ng kamote isa na yun sangkap po dyan kangkong isa na po sa ginagamit namin dyan, wala kaming gulay na tinatapon ginagawa naming ganyan

L: iniimbak niyo lang po

S: Oo iniimbak namin para maging fertilizer siya din po ang pinandidilig sa aming mga halaman

S: Kaya walang sayang

L : Pano niyo po nalalaman na okay na po yung composite na ilagay sa mga dahon dahon

S: Pinupuno pa namin yan eh, nagtutubig

L : nagtutubig

S: May sauce siya kukunin mo lang yung sabaw niya

L : Ahh yun na po yung gagamintin niyong sabaw na po

S: Oo, yun ang gagamitin, hindi siya puro nilalagyan din naman ng tubig

L: Ahh tubig po

S: Oo tinitimpla namin siya tinitimpla namin ng tubig hindi siya purong puro lang

T: Tapos yun na po yung ginagamit niyong as fertilizer po

S: Oo purong bitukang isda yan yan yung fish amino acid

T: So pwede rin po natin ilagay yan sa irrigation parang ganun

S: Pag sa irrigation spray lang siya

T: Ahh spray spray lang siya hindi siya pwede ilagay sa tubig

S: Baka mamatay pa yung ano, limited lang yung kailangan

T: Ahhh kailangan limited lang

S: Bawal po siya sa dahon, I ano mo sa lupa pero idilute mo sa tubig

L: I think nakuha na po namin yung kailangan namin malaman, Thank you po ma'am

S: Welcome

L & All : Thank you po

L: Napakahelpful po ng nabigay niyo pong information

S: Tsaka Maganda yung gulay namin dito yung organic hindi siya nakakasira ng katawan

T : Healthy, Healthy conscious

S: Yung aming gulay may butas butas siya uod yun ang totoong organic

T: Sabi nga nila pag may uod yung gulay, yun ang masarap kainin

APPENDIX H

On Field Photography


URBAN
FARMING


SUNNYVILLE FARM
TUPAD


VISITORS

APPENDIX I

Demographic Tables

Position of the workers.

Position	Frequency	Percentage
Assistant Manager	1	10%
Farmer	10	90%
Total	11	100%

Farms of the Agriculturist.

Farm	Frequency	Percentage
QCU Farm	8	80%
Sunnyville	2	20%
Total	10	100%

APPENDIX J

Survey Questionnaire

AGREEMO Application Evaluation for Agriculturists

Dear Participant,
Thank you for taking the time to participate in our survey. **The survey is about your satisfaction with the researchers' android application named AGREEMO and your insights are incredibly valuable to our research.** Before you begin, the researchers want to assure you that your privacy and the confidentiality of your responses are of the utmost importance to us. Following the **Data Privacy Act of 2012** of the Philippines, researchers are committed to safeguarding your personal information and ensuring that your data is protected. By participating in this survey, you agree to the following terms:
1. **Your participation in this survey is entirely voluntary.** You may choose to skip any questions or withdraw from the survey at any time without any consequences.
2. **All responses will be kept strictly confidential.** Data will be anonymized and aggregated to ensure that no individual participant can be identified.
3. **The information collected from this survey will be used solely for research purposes**. It will not be shared with third parties without your explicit consent.

By continuing with this survey, you acknowledge that you have read and understood the terms above and consent to the collection and use of your data as described.
Thank you for your participation and contribution to our research.

Sincerely,

Tiro, Julito III, T.

A. Name: ________________________
B. Age: __________________________
C. Gender
   ○ Male
   ○ Female
   ○ LQBTQIA ++
D. Farm
   ○ QCU Farm
   ○ Sunnyville

INSTRUCTION: For each question, please rate your level of satisfaction with our application on a scale of one to five, with **five being the highest**.

FUNCTIONALITY

1. How well does the system cover all the essential agricultural tasks required for monitoring and maintaining the hydroponics greenhouse?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. How accurately does the system monitor plant growth and health using sensors?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. How well does the system's functionality align with the specific needs of hydroponics lettuce farming?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

4. How well is the systems' measurements of the solutions used (Ex. SNAP Solution, pH down and Up)?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

COMPATIBILITY

1. How well does the system integrate with other agricultural tools and equipment, such as irrigation systems and temperature control systems?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. Is the system compliant with relevant agricultural standards and best practices for hydroponic farming?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. How well is the system adaptable to different farming methods and practices?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

4. How well does the system work with different types of hydroponics setups?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

USABILITY

5. How user-friendly is the application for agriculturists in terms of monitoring and controlling the greenhouse environment

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

6. How well is the system features designed to support agriculturists with varying levels of technological expertise?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

7. How easy is it to learn and use the automated system?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

RELIABILITY

1. How consistently does the system provide accurate and reliable data for plant health and growth monitoring?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. How effectively does the system recover from disruptions or failures to ensure continuous operation?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. How confident are you in the system's ability to give accurate data from the sensors?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

SECURITY

1. How well does the system ensure the integrity and authenticity of the collected agricultural data?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. How well is the control access to sensitive data and system functionalities?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. How satisfied are you with the system’s security features?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

AGREEMO Application Evaluation for Sunnyville Community Model Farm's Workers

Dear Participant,
Thank you for taking the time to participate in our survey. **The survey is about your satisfaction with the researchers' android application named AGREEMO and your insights are incredibly valuable to our research.** Before you begin, the researchers want to assure you that your privacy and the confidentiality of your responses are of the utmost importance to us. Following the **Data Privacy Act of 2012** of the Philippines, researchers are committed to safeguarding your personal information and ensuring that your data is protected. By participating in this survey, you agree to the following terms:
1. **Your participation in this survey is entirely voluntary.** You may choose to skip any questions or withdraw from the survey at any time without any consequences.
2. **All responses will be kept strictly confidential.** Data will be anonymized and aggregated to ensure that no individual participant can be identified.
3. **The information collected from this survey will be used solely for research purposes**. It will not be shared with third parties without your explicit consent.

By continuing with this survey, you acknowledge that you have read and understood the terms above and consent to the collection and use of your data as described. Thank you for your participation and contribution to our research.

Sincerely,

Tiro, Julito III, T.

A. Name: ________________________
B. Age: __________________________
C. Gender
   - ○ Male
   - ○ Female
   - ○ LQBTQIA ++
D. Position
   - ○ Farmer
   - ○ Farmer Manager
   - ○ Assistant Manager

INSTRUCTION: For each question, please rate your level of satisfaction with our application on a scale of one to five, with **five being the highest**.

FUNCTIONALITY
1. How effectively does the app allow you to remotely monitor and control the greenhouse environment (temperature, humidity, etc.)?
   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
2. How well does the app integrate and display data from multiple sensors simultaneously?
   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
3. How useful are the data history logs and reports in managing the farm and making informed decisions?
   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
4. How well does the application's automated nutrient controller meet your needs in maintaining the health of the lettuce plants?
   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

COMPATIBILITY

1. How well does the application perform on the devices you use (smartphone, tablet, computer)?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. How satisfied are you with the application's ability to maintain a stable connection with the database, sensors, and devices?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. How often do you experience compatibility issues with the app on your devices?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

4. Does the app offer a consistent user experience across different devices?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

USABILITY

5. How easy is it to navigate and use the application's interface for managing tasks, viewing reports, and controlling the greenhouse?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

6. How clear and informative are the data visualizations and reports generated by the application?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

7. How efficient is the app in allowing you to perform your farm management tasks?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

RELIABILITY

1. How reliable is the application in providing continuous monitoring and control of the hydroponic greenhouse?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

2. How satisfied are you with the app's performance in automating tasks and alerts?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

3. How confident are you in the accuracy of the data provided by the app?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

SECURITY

4. How secure do you feel about the farm's data within the application?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

5. How effective are the application's security measures in preventing unauthorized access to sensitive farm information?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

6. How satisfied are you with the application's handling of user access and permissions?

   ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

APPENDIX K

Database Design

admin (AdminUser)

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
login_id	Integer	No			Primary key; auto-incremented unique ID for admin users.	
name	String(50)	Yes			Admin's name; can be null.	
email	String(100)	No			Unique email address; required.	
password	String(200)	No			Hashed password; required.	
consecutive_failed_login	Integer	Yes			Number of consecutive failed logins; optional.	
failed_timer	DateTime	Yes			Time marker for failed login attempts; optional.	

analytics

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
analytics_id	Integer	No			Primary key; auto-incremented.	

greenhouse_id	Integer	No		greenhouses.greenhouse_id	References the greenhouse this analytics record belongs to.	
period	String	No			Analysis period; must be one of Daily, Monthly, or Yearly.	
average_ph	Float				Average pH value; optional.	
average_temperature	Float				Average temperature; optional.	
yield_prediction	Float				Predicted yield; optional.	
sensor_activations	Integer				Count of sensor activations; optional.	

greenhouses

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
greenhouse	Integer	No			Primary key;	

_id					auto-incremented unique ID for each greenhouse.	
user_id	Integer	No		users.user_id	References the owner/user of the greenhouse.	
name	String	No			Name of the greenhouse; required.	
location	String	Yes			Physical location; optional.	
size	Float	Yes			Size (area) of the greenhouse; optional.	
climate_type	String	Yes			Type of climate suitable; optional.	
created_at	DateTime		current_timestamp		Timestamp when the greenhouse record was created.	
status	String	No			Must be either Active or Inactive.	

hardware_components

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**

component_id	Integer	No			Primary key; auto-incremented unique ID for hardware components.	
user_id	Integer	No		users.user_id	References the user associated with the component.	
greenhouse_id	Integer	No		greenhouses.greenhouse_id	References the greenhouse where the component is installed.	
componentName	String(200)	Yes			Name of the component; optional.	
date_of_installation	DateTime	No			Installation date; required.	
manufacturer	String(200)	Yes			Manufacturer details; optional.	
model_number	String(200)	Yes			Model number; optional.	
serial_number	String(200)	Yes			Serial number; optional.	

hardware_current_status

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
status_id	Integer	No			Primary key; auto-incremented.	
component_id	Integer			hardware_components.component_id	References the hardware component.	
isActive	Boolean	No	False		Indicates if the component is active.	
greenhouse_id	Integer			greenhouses.greenhouse_id	References the greenhouse; optional.	
lastChecked	DateTime	No			Timestamp of the last status check; required.	
statusNote	String(200)	Yes			Additional status note; optional.	

harvests

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
harvest_id	Integer	No			Primary key; auto-incremented unique ID for harvest records.	
user_id	Integer	No		users.u	References the	

				ser_id	user performing the harvest.	
greenhouse_id	Integer	No		greenhouses.greenhouse_id	References the greenhouse where the harvest occurred.	
plant_type	String	No			Type of plant harvested; required.	
total_yield	Integer	No			Total yield count; required.	
accepted	Integer	No			Count of accepted produce; required.	
total_rejected	Integer	No			Count of rejected produce; required.	
harvest_date	Date		current_date		Date of harvest; default is the current date.	
notes	String	Yes			Additional notes; optional.	

maintenance

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
maintenance_id	Integer	No			Primary key; auto-incremented unique ID for maintenance records.	
user_id	Integer	No		users.user_id	References the user who performed the	

					maintenance.	
title	String	No			Title of the maintenance task; required.	
date_completed	DateTime		current_timestamp		Completion timestamp; defaults to current timestamp.	
description	String	Yes			Description of the maintenance; optional.	

nutrient_controllers

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
controller_id	Integer	No			Primary key; auto-incremented unique ID for nutrient controllers.	
greenhouse_id	Integer	No		greenhouses.greenhouse_id	References the greenhouse where the controller is installed.	
solution_type	String	No			Must be one of: pH Up, pH Down, Nutrient A, Nutrient B.	
dispensed_amount	Float	No			Amount dispensed by the controller; required.	
activated_by	String	No			Identifier (user email or "Auto") who activated the controller;	

					required.	
dispensed_time	DateTime	No			Timestamp when dispensing occurred; required.	

plant_growth

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
growth_id	Integer	No			Primary key; auto-incremented unique ID for plant growth records.	
greenhouse_id	Integer	No		greenhouses.greenhouse_id	References the greenhouse being monitored.	
plant_type	String	No			Type of plant; required.	
height	Float	Yes			Height of the plant; optional.	
leaf_count	Integer	Yes			Number of leaves; optional.	
growth_stage	String	No			Must be one of: Seedling, Vegetative, Mature, Harvest.	
observed_date	Date		current_date		Date of observation; defaults to current date.	
remarks	String	Yes			Additional remarks; optional.	

reason_for_rejection

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
rejection_i	Integer	No			Primary key; auto-	

d					incremented unique ID for rejection records.	
greenhouse_id	Integer	No		greenhouses.greenhouse_id	References the greenhouse for which the rejection is recorded.	
too_small	Integer	Yes			Count indicator if the produce was too small; optional.	
physically_damaged	Integer	Yes			Count indicator if physically damaged; optional.	
diseased	Integer	Yes			Count indicator if diseased; optional.	
rejection_date	Date				Date of rejection; optional.	
comments	String	Yes			Additional comments regarding the rejection; optional.	

sensors

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
sensor_id	Integer	No			Primary key; auto-incremented unique ID for sensors.	
greenhouse_id	Integer	No		greenhouses.greenhouse_id	References the greenhouse where the sensor is located.	
type	String	No			Sensor type; must be one of: pH, TDS, Temperature, Humidity.	
unit	String	No			Measurement unit; required.	

status	String	No			Operational status; must be either Active or Inactive.	
installed_at	DateTime		current_timestamp		Installation timestamp; defaults to current timestamp.	
last_calibrated	DateTime				Timestamp of last calibration; optional.	

sensor_readings

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
reading_id	Integer	No			Primary key; auto-incremented unique ID for sensor readings.	
sensor_id	Integer	No		sensors.sensor_id	References the sensor that generated the reading.	
reading_value	Float	No			Recorded value from the sensor; required.	
reading_time	DateTime		current_timestamp		Timestamp of the reading; defaults to current timestamp.	
unit	String	No			Unit of measurement for the reading; required.	

stored_email

Column	Type	Null	Default	Links to	Comments	Media (MIME) type

stored_email_id	Integer	No			Primary key; auto-incremented unique ID for emails.	
email	String	No			Unique email address stored; required.	

users

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
user_id	Integer	No			Primary key; auto-incremented unique ID for users.	
first_name	String	No			User's first name; required.	
last_name	String	No			User's last name; required.	
date_of_birth	Date	No			User's date of birth; required.	
email	String	No			Unique email address; required.	
phone_number	String	Yes			Unique phone number; optional.	
address	String	Yes			User address; optional.	
isAdmin	Boolean	No	False		Indicates if the user is an admin; defaults to False.	
isActive	Boolean	No	False		Indicates if the user is active; defaults to False.	
password	String(200)	No			Hashed user password; required.	
consecutive_failed_login	Integer	Yes			Count of consecutive failed login attempts; optional.	
failed_time	DateTi	Yes			Timestamp for	

r	me				failed login tracking; optional.	
isNewUser	Boolean	No	True		Indicates if the user is new; defaults to True.	

admin_activity_logs

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
log_id	Integer	No			Unique identifier for each admin activity log entry.	
login_id	Integer			admin.login_id	References the admin user (login_id) in the admin table.	
logs_description	String (255)	No			Brief description of the admin activity logged.	
log_date	DateTime	No			Date and time when the log entry was recorded.	

greenhouse_activity_logs

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
log_id	Integer	No			Unique identifier for each greenhouse activity log entry.	
login_id	Integer			users.user_id	References the user who performed the activity.	
greenhouse_id	Integer			greenhouses.greenhouse_id	References the greenhouse related to the activity.	

logs_description	String (255)	No			Description of the greenhouse activity.	
log_date	DateTime	No			Date and time when the log entry was recorded.	

hardware_components_activity_logs

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
log_id	Integer	No			Unique identifier for each hardware component activity log.	
login_id	Integer			users.user_id	References the user who performed the activity.	
component_id	Integer			hardware_components.component_id	References the hardware component related to the activity.	
logs_description	String (255)	No			Description of the hardware component activity.	
log_date	DateTime	No			Date and time when the log entry was recorded.	

hardware_status_activity_logs

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
log_id	Integer	No			Unique identifier for each hardware status activity log	

					entry.	
logs_description	String(200)				Description of the hardware status activity.	
timestamp	DateTime	No			Date and time when the status was recorded.	
status	Boolean	No	False		Status indicator (True/False).	
duration	String(200)				Duration information related to the status event.	
component_id	Integer			hardware_components.component_id	References the hardware component in question.	
greenhouse_id	Integer			greenhouses.greenhouse_id	References the related greenhouse.	

harvest_activity_logs

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
log_id	Integer	No			Unique identifier for each harvest activity log entry.	
login_id	Integer			users.user_id	References the user who performed the harvest activity.	
harvest_id	Integer			harvests.harvest_id	References the specific harvest related to the activity.	
logs_description	String(255)	No			Description of the harvest activity.	
log_date	DateTi	No			Date and time	

	me				when the log entry was recorded.	

maintenance_activity_logs

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
log_id	Integer	No			Unique identifier for each maintenance activity log entry.	
login_id	Integer			users.user_id	References the user who performed the maintenance activity.	
maintenance_id	Integer			maintenance.maintenance_id	References the specific maintenance record associated with the log.	
logs_description	String(255)	No			Description of the maintenance activity.	
log_date	DateTime	No			Date and time when the log entry was recorded.	

nutrient_controller_activity_logs

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
log_id	Integer	No			Unique identifier for each nutrient controller activity log entry.	
controller_id	Integer			nutrient_controllers.controller_i	References the nutrient controller related to the activity.	

				d		
logs_description	String (200)				Description of the nutrient controller activity.	
logs_date	DateTime	No			Date and time when the log entry was recorded.	
greenhouse_id	Integer			greenhouses.greenhouse_id	References the greenhouse related to the nutrient controller activity.	
activated_by	String (200)	No			Identifier (email or "Auto") for who activated the nutrient controller.	

rejection_activity_logs

Column	**Type**	**Null**	**Default**	**Links to**	**Comments**	**Media (MIME) type**
log_id	Integer	No			Unique identifier for each rejection activity log entry.	
login_id	Integer			users.user_id	References the user who performed the rejection action.	
rejection_id	Integer			reason_for_rejection.rejection_id	References the reason for rejection record.	
logs_description	String(255)	No			Description of the rejection activity.	
log_date	DateTime	No			Date and time when the log entry was recorded.	

user_activity_logs

Column	Type	Null	Default	Links to	Comments	Media (MIME) type
log_id	Integer	No			Unique identifier for each user activity log entry.	
login_id	Integer			users.user_id	References the user who performed the activity.	
logs_description	String(255)	No			Description of the user activity.	
log_date	DateTime	No			Date and time when the log entry was recorded.	

APPENDIX L

Letter of Acceptance

QUEZON CITY UNIVERSITY
COLLEGE OF COMPUTER STUDIES
Information Technology Department

May 23, 2025

QCU's Farmer Manager
Quezon City University
673 Quirino Highway, San Bartolome Novaliches, Quezon City

To QCU's Farmer Manager,

The researchers from SBIT-4A, Group 2 at Quezon City University formally donate the hardware and system of **AGREEMO: Development of an Android Application for Solar-Powered Hydroponics Greenhouse with Plant Monitoring and Automatic Nutrient Controller.**

The researchers' goal is to contribute to the advancement of the university's agricultural practices by using technologic instruments such as their capstone donation. They believe that through this donation, they can help sustain the health of lettuces and reducing manual processing of farmers.

Please note that while the researchers are willingly donating the system, the following conditions will apply:

1. **The researchers are not liable for system performance**, they are not be held liable for any technical issues, defects, or inefficiencies arising from the use or implementation of the donated hardware and system.
2. **The researchers will not provide maintenance or support obligation**, they have no obligation to provide technical support or post-implementation services. Future maintenance, troubleshooting, and upgrades of the donated system shall be the sole responsibility of Quezon City University Farm
3. **The researchers will not provide warranty or guarantee**, the donation is provided "as is," without any express or implied warranties regarding its functionality, durability, or effectiveness.
4. **The researchers are not liable for Third-Party damages**, they are not responsible for any damages, incidental or consequential, caused by the use or malfunction of the AGREEMO system.

By accepting this donation, Quezon City University Farm acknowledges these conditions and releases Group 2, SBIT-4A, from any related liabilities.

We appreciate the opportunity to contribute to this initiative and hope the system supports your agricultural efforts.

Sincerely yours,

Julito III T. Tiro
Project Manager

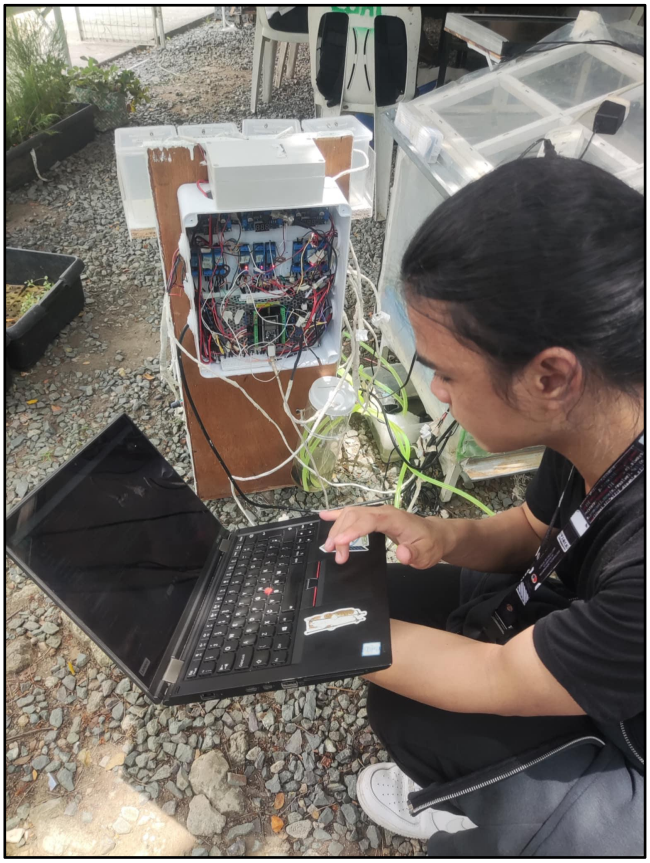
Noted by:

Norilyn C. Sindanum, MAIE
Capstone Project Mentor
Quezon City University

5-22-2025

APPENDIX M

Photo Documentary During Prototype Turnover to QCU Farm



APPENDIX N

Grammarian Certification

CERTIFICATION OF ENGLISH CRITIQUE AND GRAMMAR EDITING

May 22, 2025

To whom it may concern,

This is to certify that the proponents of the capstone project titled

"AGREEMO: DEVELOPMENT OF AN ANDROID APPLICATION FOR SOLAR-POWERED HYDROPONICS GREENHOUSE WITH PLANT MONITORING AND AUTOMATIC NUTRIENT CONTROLLER"

submitted in partial fulfillment of the requirements by:

Aguilar, Jay Angelo V.
Arca, Mark Gervic
Aropon, Mark James B.
Cabaya, Dane Justine C.
Cabrera, Rachel Jhoy L.
Canales, Allyson E.
Castromayor, Jay Boy A.
Delotavo, Giebert R.
Delos Santos, Cris Christian D.
Lagleva, Ashley Nicole
Libardo, Noel Jr. R.
Lladones, Leomar C.
Mojares, Ashley Jade
Pecoro, Kathleen Mae A.
Tabios, Maria Alesa S.
Tiro, Julito III, T.

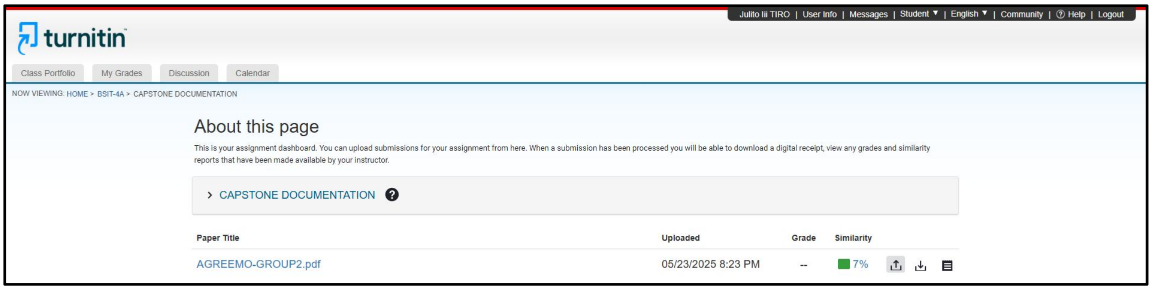
Has been EDITED for language consistency and grammatical coherence. The manuscript has been reviewed and found acceptable in terms of spelling, grammar, composition, and overall style.

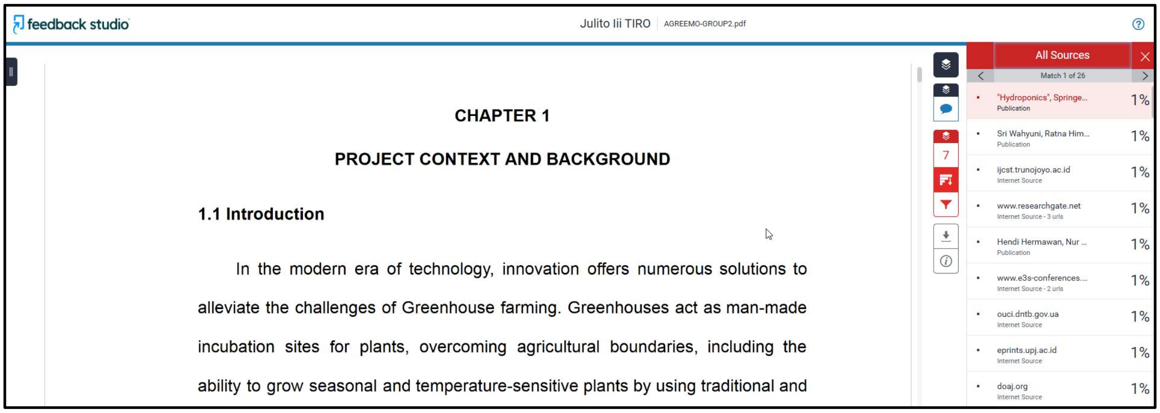
Neither the manuscript's content nor the authors' intentions were altered in any way during the editing and proofreading process.

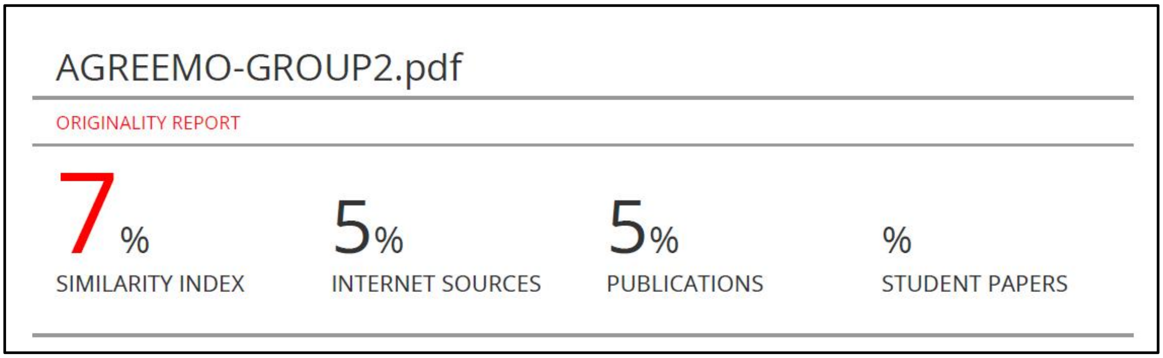
AYUMI ASHLEY S. DELA CRUZ, LPT
Professional Grammar Consultant
Bachelor of Secondary Education Major in English
PRC License. No. 1991159

APPENDIX O

Turnitin Results







turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Julito Iii TIRO
Assignment title:	CAPSTONE DOCUMENTATION
Submission title:	AGREEMO-GROUP2.pdf
File name:	AGREEMO-GROUP2.pdf
File size:	5.29M
Page count:	165
Word count:	20,174
Character count:	118,130
Submission date:	23-May-2025 08:23PM (UTC+0800)
Submission ID:	2683007016

CHAPTER 1

PROJECT CONTEXT AND BACKGROUND

1.1 Introduction

In the modern era of technology, innovation offers numerous solutions to alleviate the challenges of Greenhouse farming. Greenhouses act as man-made incubation sites for plants, overcoming agricultural boundaries, including the ability to grow seasonal and temperature-sensitive plants by using traditional and innovative planting. Hydroponics is one innovative way of planting. It's a process of nurturing plants with water and nutrient solutions to deliver essential elements for plant growth.

Hydroponics mitigates water loss, which reduces runoff and the need for pesticides and herbicides caused by microorganisms. It's also great in urban farming because it maximizes space by vertically stacking the plants, which conserves resources and increases the production of crops. However, hydroponics still has its disadvantages. One of its many disadvantages is its vulnerability to power outages because it's reliant on electricity and primarily uses electronic instruments to provide water flow throughout the system. Hydroponics requires constant monitoring of water conditions, which are pH level and nutrients. Many commercial hydroponic greenhouses use automated systems that monitor and control water conditions, reducing the manual work for farmers.

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APPENDIX P

Copyright Application

Certificate of Copyright Application

QUEZON CITY UNIVERSITY
RESEARCH, EXTENSION, PLANNING AND LINKAGES
INNOVATION AND TECHNOLOGY SUPPORT OFFICE

CERTIFICATE OF COPYRIGHT APPLICATION

The Office received the Copyright Application of the work with the following details:

Title : AGREEMO: Development of an Android Application for Solar-Powered Hydroponics Greenhouse with Plan Monitoring and Automatic Nutrient Controller

Authors :

Jay Angelo V. Aguilar
Marc Gervic P. Arca
Mark James B. Aropon
Dane Justine C. Cabaya
Rachel Jhoy L. Cabrera
Allyson E. Canales
Jay Boy A. Castromayor
Giebert R. Delotavo
Cris Christian D. Delos Santos
Ashley Nicole R. Lagleva
Noel Jr. R. Libardo
Leomar C. Lladones
Ashley Jade T. Mojares
Kathleen Mae A. Pecoro
Maria Alesa S. Tabios
Julito III T. Tiro

Maria Aura C. Impang, LPT, MSIT
General Manager, Innovation and Technology Support Office

Record of Copyright Application

QUEZON CITY UNIVERSITY
RESEARCH, EXTENSION, PLANNING AND LINKAGES
INNOVATION AND TECHNOLOGY SUPPORT OFFICE

RECORD OF COPYRIGHT APPLICATION

The Office received the Copyright Application of the work with the following details:

College and Program : Bachelor of Science in Information Technology

Title : AGREEMO: Development of an Android Application for Solar-Powered Hydroponics Greenhouse with Plant Monitoring and Automatic Nutrient Controller

Authors : Jay Angelo V. Aguilar, Marc Gervic P. Arca, Mark James B. Aropon, Dane Justine C. Cabaya, Rachel Jhoy L. Cabrera, Allyson E. Canales, Jay Boy A. Castromayor, Giebert R. Delotavo, Cris Christian D. Delos Santos, Ashley Nicole R. Lagleva, Noel Jr. R. Libardo, Leomar C. Lladones, Ashley Jade T. Mojares, Kathleen Mae A. Pecoro, Maria Alesa S. Tabios, Julito III T. Tiro

Contact Number : +639616049255

Email Address : tiro.julitoiii.14@gmail.com

The Applicant submitted the following details:

- Single (1) digital copy of Copyright Registry Enrollment Form
- Digital Copy of Supplementary form
- 3 Original & (1) digital copy of duly notarized Deed of Assignment
- Digital copy of the Manuscript
- Single (1) digital copy of Approval Sheet with complete signature/s
- Digital copy of Turnitin result
- Original receipt of payment

Julito III T. Tiro
Name of Applicant

APPENDIX Q

Curriculum Vitae

JAY ANGELO V. AGUILAR
#18 T. Gonzales Drive Gulod Novaliches
Quezon City
09155232822
aguilar.jayangelo.09082002@gmail.com

CAREER OBJECTIVES

I want to excel in this field with hard work, perseverance and dedication. I want a highly rewarding career where I can use my skills and knowledge for organizational and personal growth. I am seeking a company where I can use my experience and education to help the company meet and surpass its goal.

PERSONAL QUALIFICATION

- Creativity
- Time Management
- Flexible
- UI/UX Design (Canva and Figma)
- Microsoft Office: (Word, PPT and Excel)

PERSONAL INFORMATION

Date of Birth: September 08, 2002
Place of Birth: Camarines Sur
Citizenship: Filipino
Gender: Male
Civil Status: Single
Interest: Music, Arts and Movies

EDUCATIONAL BACKGROUND

Primary: Rosa L. Susano Novaliches Elementary School	2009-2015
Secondary: San Bartolome High School	2015-2019
Tertiary: Quezon City University (BS Information Technology)	2021-2025

MARK GERVIC P. ARCA
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CAREER OBJECTIVES

Dedicated IT aspirant specializing in web development and software engineering, ready to utilize analytical skills and a flair for innovation, along with proven collaborative abilities, to contribute effectively to organizational achievements.

PERSONAL QUALIFICATION

- Graphic Designer / UI-UX Designer
- Proficient in Figma for Prototyping and Designing.
- Foundational Knowledge in Adobe Photoshop and Lightroom.
- Skilled in HTML, CSS, and JavaScript Programming.
- Skilled in Database management in SQL, MYSQL, and Oracle.
- Strong Communication Skills
- Strong Customer Service Skills

PERSONAL INFORMATION

Date of Birth: November 27, 2002
Place of Birth: Quezon City
Citizenship: Filipino
Gender: Male
Civil Status: Single

EDUCATIONAL BACKGROUND

Primary: Lupang Pangako Elementary School	2009-2015
Secondary: Datamex College of Saint Adeline	2015-2019
Tertiary: Quezon City University (Information Technology)	2021-2025

MARK JAMES AROPON

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CAREER OBJECTIVES

Dedicated and innovative BS Information Technology student at Quezon City University with a strong passion for software development, IoT, and machine learning. Eager to apply technical expertise to build efficient solutions that drive innovation and optimize processes.

PERSONAL QUALIFICATION

- Skills: Programming**:** Python, C#, JavaScript, Dart, PhP
- Frameworks: TensorFlow, Flask, ASP.NET, Node.js
- Database: Firebase, SQL, Cloud Database
- Web: HTML, CSS, JavaScript, ASP.NET

PERSONAL INFORMATION

Date of Birth: August 17, 2002
Place of Birth: Quezon City
Citizenship: Filipino
Gender: Male
Civil Status: Single
Interest: Movies, Anime, Music

EDUCATIONAL BACKGROUND

Primary: Lagro Elementary School	2009-2015
Secondary: Lagro High School	2015-2021
Tertiary: Quezon City University (BS Information Technology).	2021 - 2025

DANE JUSTINE C. CABAYA
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CAREER OBJECTIVES

Passionate individual with a strong interest in the ever-evolving field of Information Technology. Eager to apply skills in a hands-on role within the IT industry. Possesses excellent communication abilities and a deep enthusiasm for learning. Committed to gaining practical experience and contributing to the growth of an organization in the dynamic world of IT.

PERSONAL QUALIFICATION

- Management Skills
- Editing
- Flexibility
- Decision Making
- Computer Literate
- Fast Learner

PERSONAL INFORMATION

Date of Birth: October 28, 2001
Place of Birth: Ilocos Sur
Citizenship: Filipino
Gender: Male
Civil Status: Single
Interest: Sports, Computer and mobile Gaming, workout.

EDUCATIONAL BACKGROUND

Primary: Ramon Magsaysay Elementary School	2008-2014
Secondary: E.rodriguez Jr. High School	2014-2018
Secondary Level 11 and 12: Southeast Asian College, Inc.	2018-2020
Tertiary: Quezon City University (BS Information Technology).	2021-2025

RACHEL JHOY L. CABRERA
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CAREER OBJECTIVES

As a Bachelor of Science in Information Technology student, I aim to gain knowledge and skills in information technology to help solve problems and create efficient systems. I am eager to learn, improve my abilities, and contribute to the success of an organization while growing in the field of technology.

PERSONAL QUALIFICATION

- Lego Educational Robotics and Computer Technical Training (2018)
- Civil Service Exam Passer - Professional (2024)
- Tara Basa Tutoring Program of DSWD - Youth Development Worker (2024)
- Skills: Computer Literate, IT knowledge, Communication Skill, Fast Learner, Active Listener, and Detail Oriented

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PERSONAL INFORMATION

Date of Birth: February 20, 2002
Place of Birth: Marikina City
Citizenship: Filipino
Gender: Female
Civil Status: Single
Interest: Reading, Computer and Gaming

EDUCATIONAL BACKGROUND

Primary: Horacio Dela Costa Elementary School	2009-2015
Secondary: Lagro High School	2015-2021
Tertiary: Quezon City University (BS Information Technology).	2021- 2025

ALLYSON E. CANALES
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CAREER OBJECTIVES

To be part of a company or organization where I can actively use, expand, and contribute my knowledge and skills to foster the growth of the organization.

PERSONAL QUALIFICATION

- Computer Literate
- Time Management
- Flexible
- Microsoft Tools (MS Word, PPT, and Excel)
- Digital Illustration
- UI/UX Design (Figma and Canva)
- Video Editing
- Layout Editing
- Basic Photoshop

PERSONAL INFORMATION

Date of Birth: July 16, 2002
Place of Birth: Manila
Citizenship: Filipino
Gender: Female
Civil Status: Single
Interest: Chinese Drama, Remix, Editing, and Digital Art

EDUCATIONAL BACKGROUND

Primary: San Francisco Elementary School	2009-2015
Secondary: Sergio Osmena Sr. High School	2015-2019
Perpetual Help College of Manila	2019-2021
Tertiary: Quezon City University (BS Information Technology).	2021- 2025

JAY BOY A. CASTROMAYOR

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CAREER OBJECTIVES

An IT student with strong skills in troubleshooting hardware and software issues. I'm eager to apply my technical expertise to help improve system performance and support a team in solving everyday tech challenges.

PERSONAL QUALIFICATION

- **Skills**: Computer Literate, Basic IT knowledge in Hardware & Software.
- **Technical Skills:** Application Development using VB.NET and Visual Studio
- **Additional Skills:** basic knowledge in electrical wiring

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PERSONAL INFORMATION

Date of Birth: June 26, 2002
Place of Birth: Mandaluyong City
Citizenship: Filipino
Gender: Male
Civil Status: Single

EDUCATIONAL BACKGROUND

Primary: Melencio M. Castelo Elementary School (MMCES)	2008-2014
Secondary: Batasan Hills National High School (BHNHS)	2014-2018
Secondary Level 11 & 12: Our Lady of Fatima University (OLFU)	2018-2020
Tertiary: Quezon City Polytechnic University (QCU)	2021-2025

GIEBERT R. DELOTAVO

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Quezon City
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CAREER OBJECTIVES

A passionate technology enthusiast aspiring to build a successful career in Information Technology. Eager to apply theoretical knowledge, develop practical skills, and continuously learn and grow while contributing to innovative and dynamic environments.

PERSONAL QUALIFICATION

- **Technical Skills:** Python, Java, SQL, Web Development, Application Development using VB.NET and Visual Studio
- **Soft Skills:** Good Listener, Problem Solving
- **Tools:** Visual Studio, Visual Studio Code
- **Additional Skills**: Familiar with Computers, including troubleshooting, software installation, and basic hardware knowledge

PERSONAL INFORMATION

Date of Birth: October 20, 2002
Place of Birth: Manila City
Citizenship: Filipino
Gender: Male
Civil Status: Single
Interest: Programming, Computer and Gaming

EDUCATIONAL BACKGROUND

Elementary: Iguid Elementary School	2008-2014
Junior High School: Justice Cecilia Muñoz Palma High School	2014-2018
Senior High School: New Era University	2018-2020
College: Quezon City University – Present 4th Year College	2021 - 2025

CRIS CHRISTIAN D. DELOS SANTOS

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Quezon City
09458904624
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CAREER OBJECTIVES

To contribute and be a part of a company or organization where I can use, learn and contribute my skills and talents to grow. I am motivated to learn and contribute to society to grow in the field I am taking.

PERSONAL QUALIFICATION

- Safety Measures: Involving Students in Creating Safer Online Environment (2021)
- End Inequalities, End AIDS, End Pandemic (2021)
- Talents: Creativity, Critical Thinking, Problem Solving
- Skills: Computer Literate, IT knowledge, Communication Skill, Fast Learner, Active Listener, and Detail Oriented

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PERSONAL INFORMATION

Date of Birth: June 17, 2003
Place of Birth: Quezon City
Citizenship: Filipino
Gender: Male
Civil Status: Single
Interests: Music, Art, Games

EDUCATIONAL BACKGROUND

Primary: St. Jerome School of Novaliches	2008-2015
Secondary: Novaliches High School	2015-2021
Tertiary: Quezon City University (BS Information Technology).	2021-2025

ASHLEY NICOLE R. LAGLEVA

5D Sta. Catalina St. Brgy. N.S. Amoranto, Quezon City
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lagleva.ashleynicole.02042002@gmail.com

CAREER OBJECTIVES

To utilize the knowledge and skills I've attained through my academic studies as my foundation in a challenging and dynamic work environment. I am eager to contribute to an organization that values growth and innovation while continuing to develop professionally and expand my expertise in various professional areas.

SKILLS

- Microsoft Office Suite: (Excel, Word, PPT)
- Communication Skills
- Problem Solving
- Time Management
- Customer Service

PERSONAL INFORMATION

Date of Birth: February 04, 2002
Place of Birth: Manila
Citizenship: Filipino
Gender: Female
Civil Status: Single
Interest: Reading Manhwa and Manga, Watching Korean Variety Show and Series

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EDUCATIONAL BACKGROUND

Primary: Dr. A. Albert Elementary School	2008-2014
Secondary: E. Rodriguez Jr. High School	2014-2018
Southeast Asian College, Inc.	2018-2020
Tertiary: Quezon City University (BS Information Technology).	2021-2025

LIBARDO, NOEL JR. R.

Blk 02 Lot 23 Purok 20 Unit V Barangay, Commonwealth
Quezon City
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CAREER OBJECTIVES

Aspiring IT professional with a strong interest in web development and software engineering, eager to apply creative problem-solving abilities and fresh innovative ideas, supported by practical project experience, to benefit the organization.

PERSONAL QUALIFICATION

- Graphic Designer / UI-UX Designer
- Proficient in Figma for Prototyping and Designing.
- Foundational Knowledge in Adobe Photoshop and Lightroom.
- Skilled in HTML, CSS, and JavaScript Programming.
- Skilled in Database management in SQL, MYSQL, and Oracle.
- Strong Communication Skills
- Strong Customer Service Skills

PERSONAL INFORMATION

Date of Birth: October 12, 2002
Place of Birth: Quezon City
Citizenship: Filipino
Gender: Male
Civil Status: Single

EDUCATIONAL BACKGROUND

Primary: Manuel L. Quezon Elementary School	2009-2015
Secondary: Dr. Carlos S. Lanting College	2015-2021
Tertiary: Quezon City University (Information Technology)	2021-2025

LEOMAR C. LLADONES
Barangay Greater Lagro Subdivision
Quezon City
09215195104
lladones.leomar.11062002@gmail.com

CAREER OBJECTIVES

Aspiring IT professional with a passion for web development and software engineering, eager to apply skills in problem-solving and innovation to contribute to organizational success.

PERSONAL QUALIFICATION

- Graphic Designer / UI-UX Designer
- LESIT (League of Excellent Students in Information Technology) (2021) - Management and Development Committee
- SUPREME STUDENT COUNCIL - Information Dissemination Committee
- Proficient in Figma for Prototyping and Designing.
- Foundational Knowledge in Adobe Photoshop and Lightroom.
- Skilled in HTML, CSS, and JavaScript Programming.
- Skilled in Database management in SQL, MYSQL, and Oracle.
- Strong Communication Skills
- Strong Customer Service Skills

PERSONAL INFORMATION

Date of Birth: November 6, 2002
Place of Birth: Quezon City
Citizenship: Filipino
Gender: Male
Civil Status: Single
Interest: Programming, Photo Editing, Designing and Database Designing

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EDUCATIONAL BACKGROUND

Primary: Lagro Elementary School	2009-2015
Secondary: Lagro High School	2015-2021
Tertiary: Quezon City University (BS Information Technology).	2021- 2025

ASHLEY JADE T. MOJARES
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09624366743
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CAREER OBJECTIVES

To exploit my knowledge and skills to the fullest and also to improve them in work. Eager to apply my knowledge and skills in a dynamic learning environment. Passionate about continuous learning and seeking an internship or entry-level opportunity to gain experience.

PERSONAL QUALIFICATION

- Skills: Adaptability and willingness to learn and Time management

PERSONAL INFORMATION

Date of Birth: May 14, 2003
Place of Birth: Quezon City
Citizenship: Filipino
Gender: Female
Civil Status: Single
Interest: Cooking and Reading books or e-books

EDUCATIONAL BACKGROUND

Primary: Doña Juana Elementary School	2008-2015
Secondary: Holy Spirit National High School	2015-2021
Tertiary: Quezon City University (BS Information Technology).	2021-2025

KATHLEEN MAE A. PECORO
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CAREER OBJECTIVES

To build a career in Information Technology by applying my technical skills, problem-solving abilities, and passion for innovation. I aim to contribute to organizational success while continuously learning and growing in a challenging and supportive environment.

SKILLS

- Microsoft Office Suite: (Excel, Word, PPT, Outlook)
- Critical Thinking
- Time Management
- Video Editing

PERSONAL INFORMATION

Date of Birth: January 31, 2003
Place of Birth: Manila City
Citizenship: Filipino
Gender: Female
Civil Status: Single
Interest: Watching Korean Drama and Gaming

EDUCATIONAL BACKGROUND

Primary:	Cong. Reynaldo A. Calalay Memorial Elementary School	2009-2015
Secondary:	Sergio Osmeña Sr. High School	2015-2019
	San Francisco High School	2019-2021
Tertiary:	Quezon City University (BS Information Technology).	2021-2025

MARIA ALESA S. TABIOS
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09306193749
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CAREER OBJECTIVES

To obtain an entry-level position in Information Technology where I can utilize my Technical skills and contribute to the growth of the company while developing my professional skills.

SKILLS

- Microsoft Office Suite: (Excel, Word, PPT, Outlook)
- Critical Thinking
- Time Management
- Video Editing

PERSONAL INFORMATION

Date of Birth: March 10, 2003
Place of Birth: Quezon City
Citizenship: Filipino
Gender: Female
Civil Status: Single
Interest: Watching Documentaries and Dancing

EDUCATIONAL BACKGROUND

Primary: Toro Hills Elementary School	2009-2015
Secondary: Pugad Lawin High School	2015-2019
Nick M. Joaquin Senior High School	2019-2021
Tertiary: Quezon City University (BS Information Technology).	2021-2025

JULITO III T. TIRO
21 Don Carlos St. Barangay Holy Spirit,
Quezon City
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CAREER OBJECTIVES

Motivated IT enthusiast passionate about web development and software engineering, dedicated to leveraging problem-solving skills and innovative thinking—combined with hands-on teamwork experience—to drive organizational success.

PERSONAL QUALIFICATION

- Graphic Designer / UI-UX Designer
- Proficient in Figma for Prototyping and Designing.
- Foundational Knowledge in Adobe Photoshop and Lightroom.
- Skilled in HTML, CSS, and JavaScript Programming.
- Skilled in Database management in SQL, MYSQL, and Oracle.
- Strong Communication Skills
- Strong Customer Service Skills

PERSONAL INFORMATION

Date of Birth: June 9, 1990
Place of Birth: Misamis Oriental
Citizenship: Filipino
Gender: Male
Civil Status: Married

EDUCATIONAL BACKGROUND

Primary: Deparo Elementary School	1996-2002
Secondary: Deparo High School	2002-2006
Tertiary: Quezon City University (Information Technology)	2021-2025