DESIGN DOCUMENT

Woody

Container Farm Project

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Function Overview

Woody is an app that turns basic container greenhouses into smart farms. With Woody, fleet owners can keep an eye on all their containers and do not need to worry about the security of their fleet. Meanwhile, farm technicians can easily manage the plants from outside the container, thanks to the various sensors monitoring and controlling the environmental conditions of the plants.

Design Overview

Screen Analysis

User Authentication

First page that the user is greeted with when entering the application. Allows the user to create an account or log into their already existing one. Once authentication is completed, they are redirected to the home page.

Settings

Allows the user to view and edit user profile information, as well as notification settings.

Home Page

Displays list of containers and their status. Each container item, when clicked, redirects the user to the container-specific dashboard page (where sensor information and controls are located). As well, displays a quick overview of upcoming tasks.

Task

Displays list of upcoming tasks and their information (deadline, category..) Users can filter tasks by three time conditions: due today, in the next week or in the next month. Users can also create new tasks from this page.

Dashboard

Contains a navigation bar at the top that allows the user to switch between overview and container-specific pages.

Overview

Displays a list of container cards, which contains their overall environmental conditions (temperature, humidity and soil moisture) and their lock status. If the user is a fleet owner, they can create new containers and edit already existing ones from this page.

Container Specific

Displays more in-depth information about the environmental and security conditions of the container. The security conditions are displayed using a chart that compares the latest readings of the security sensors (past twelve hours)

At the bottom, there is a card where users can remotely control the fan, lights, lock and more of the container.

Map

This page is only available to the fleet owner. Displays a list of container cards that when expanded, show a map with the container location and information, such as coordinates and container angles (pitch, yaw and roll).

Analytics

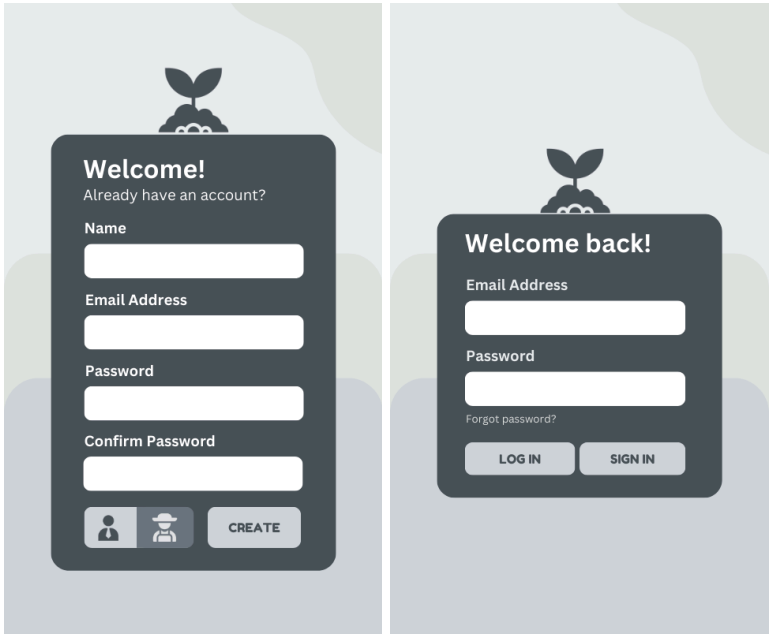
This page is only available to the fleet owner. Displays a series of graphs comparing readings of the containers' environmental conditions versus set thresholds. As well, displays a list of past security breaches.

About Us

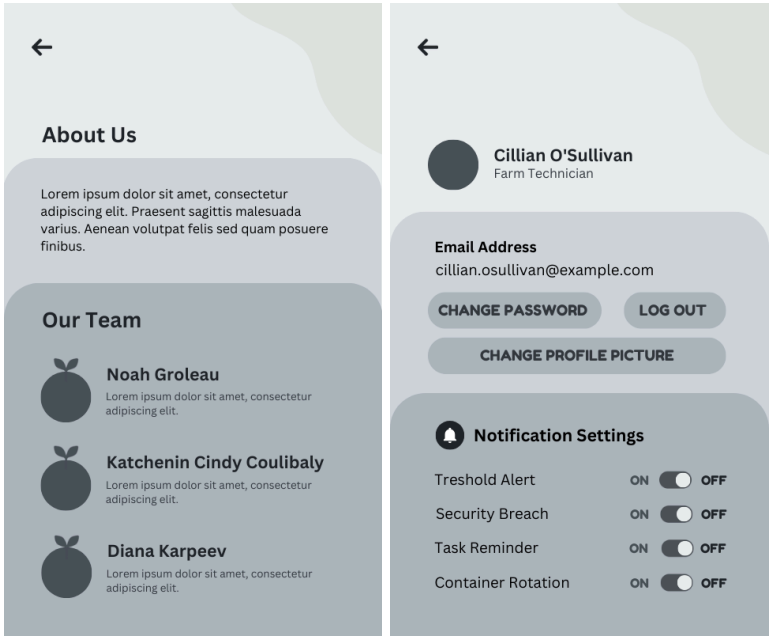
Displays short descriptions of our goals and team members with help and support info. Provides useful information for fleet owners and farm technicians.

App Prototype

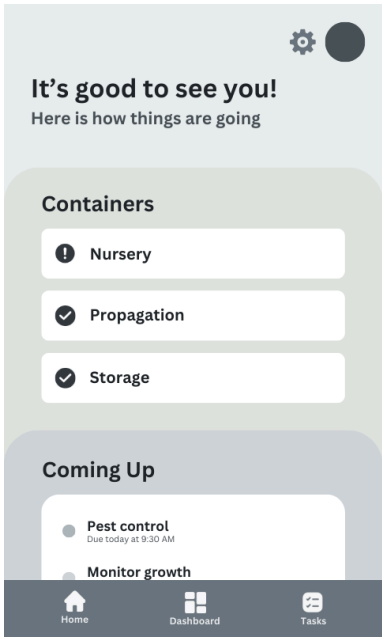
User Authentication Pages

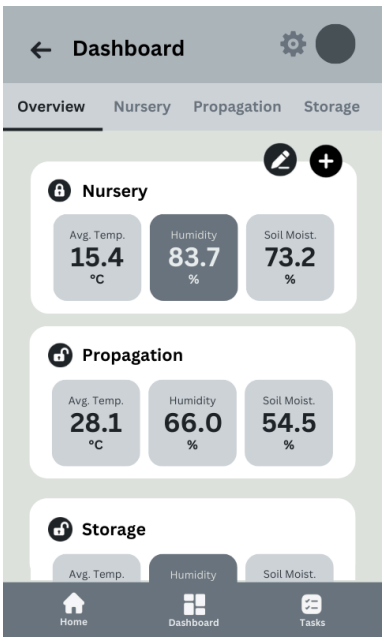


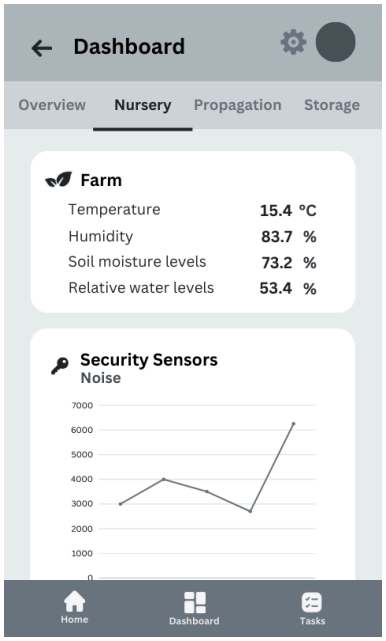
About Us and User Settings

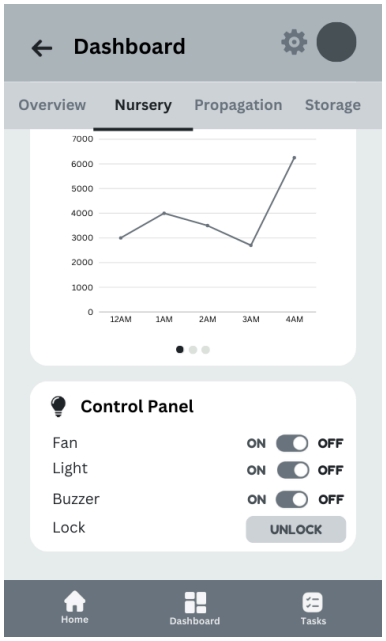


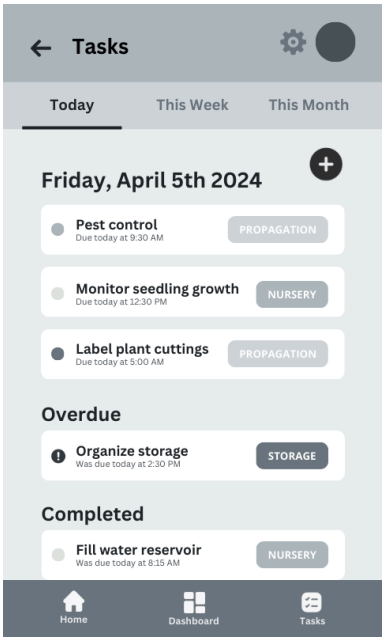
Farm Technician View





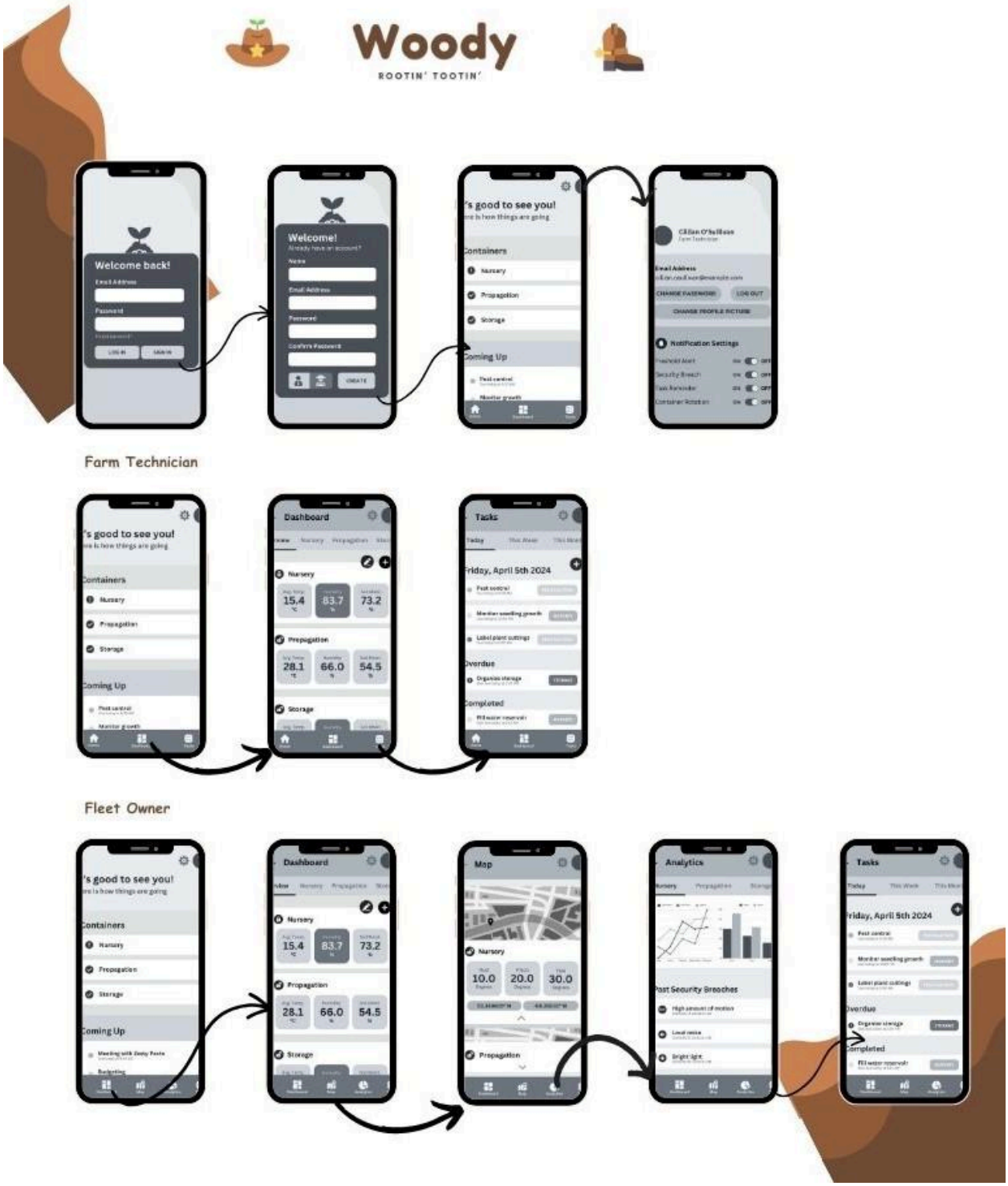






Fleet Owner View

Screen Relations



App Features

High Priority

General

- User Authentication: As a user, I want to authenticate myself so that I can access my account securely.
- Save User Preferences: As a user, I want to save my preferences so that I can personalize my experience.
- Notifications on Certain Events: As a user, I want to receive notifications on specific events (e.g., thresholds breached, security alerts) so that I can stay informed and take action.
- Tab Bar for Navigation: As a user, I want a tab bar to navigate between pages easily so that I can access different sections of the app quickly.
- Role-Specific Views and Functionalities: As a user, I want role-specific views and functionalities so that I can perform tasks relevant to my role efficiently.
- Display List of Containers: As a user, I want to view a list of containers so that I can manage and monitor them.
- Ability to Control Container Security Conditions: As a user, I want to control container security conditions so that I can ensure the security of the containers.
- Display Container Security Conditions: As a user, I want to view container security conditions so that I can assess the security status of the containers.
- Data Representation by Graphs:
    - As a user, I want to view and track data changes over time about different subsystems so that I can monitor performance trends.
    - As a user, I want to view and track data in an intuitive way so that I can easily understand the data.
    - As a user, I want to compare data with set thresholds so that I can identify deviations from expected values.
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Farm Technician Specific

- Ability to control container environmental conditions: As a farm technician, I want to control container environmental conditions so that I can maintain optimal conditions for crops.
- Display container environmental conditions: As a farm technician, I want to view container environmental conditions so that I can monitor and adjust conditions as needed.
- Saves User-Defined Thresholds for Monitored Data: As a farm technician, I want to save user-defined thresholds for monitored data (e.g., min/max temperatures) so that I can set custom alerts for specific conditions.

Fleet Owner Specific

- Display container geolocation: As a fleet owner, I want to view container geolocation so that I can track the location of my containers.
- Ability to Create or Delete Containers: As a fleet owner, I want the ability to create or delete containers so that I can manage my fleet effectively.
- Ability to Modify Individual Containers: As a fleet owner, I want the ability to modify individual containers so that I can update container details accurately.
- Provide a View on Historical Security Highlights: As a fleet owner, I want to view historical security highlights and changes over a given span of time so that I can assess the security posture of my containers over time.
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Medium Priority

General

- Ability to Modify User Profile Information: As a user, I want to modify my user profile information so that I can keep my account up to date.
- Ability to Customize Thresholds: As a user, I want to customize thresholds so that I can tailor alerts and notifications to my preferences.

- Notifications Specific to User's Credentials: As a user, I want notifications that are specific to my credentials so that I receive relevant alerts and updates.
- Accessibility and Responsiveness: As a user, I want the app to be accessible and responsive so that I can use it on various devices and screen sizes.
- Networking: Robust Mechanisms: As a user, I want robust mechanisms in case of network disruptions so that I can continue to use the app without interruption.
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Low Priority

General

- Tasks Notify User When Approaching Deadline: As a user, I want tasks to notify me when approaching a deadline so that I can manage my time effectively.
- About Us Page with Help & Support Info: As a user, I want an about us page with help & support info so that I can learn more about the app and get assistance when needed.
- Geolocation Page Displays Visualization: As a user, I want the geolocation page to display a visualization of the container so that I can visually track the location of my containers.
- Ability to Set Tasks from a Tasks Page: As a user, I want the ability to set tasks from a Tasks Page so that I can manage my tasks efficiently.
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Potential Showstoppers and Open ended questions

- Should the technician be able to control the color of the light?
- Should the technician be able to control the pulse duration of the light?
- What sensor are we using for measuring luminosity?
- Potential showstopper: Azure not working as intended

Cloud Infrastructure

Possible steps:

To connect Raspberry Pi scripts to a mobile app using Microsoft Azure as the cloud infrastructure and IoT gateway, you will need to follow these steps:

1. Set Up Azure IoT Hub and Device Provisioning Service (DPS):
    - Create an Azure IoT Hub to manage device connections and data routing.
    - Set up an Azure IoT Hub DPS to simplify device provisioning and securely connect devices to the IoT Hub.
    - Link the DPS to the IoT Hub to enable devices to be automatically registered and assigned to the IoT Hub upon provisioning.
2. Configure the Raspberry Pi as an IoT Device:
    - Use the Azure IoT Hub SDK for Python on the Raspberry Pi to connect to the IoT Hub.
    - Implement the necessary scripts on the Raspberry Pi to send data to the IoT Hub.
3. Develop the Mobile App with .NET MAUI:
    - Use Visual Studio 2022 with the necessary workloads for ASP.NET, Azure, and .NET MAUI development.
    - Create a .NET MAUI app that will serve as the user interface for both Android and iOS devices.
    - Integrate the Azure Mobile Apps backend to connect the mobile app to the Azure infrastructure.
4. Implement Cloud-to-Device (C2D) Communication:
    - Utilize Azure IoT Hub's capabilities for C2D communication to send commands or data from the cloud to the Raspberry Pi.
    - Implement features such as Direct Methods, Twin Desired Properties, and File Upload as needed for your application.
5. Secure the Connection:
    - Ensure secure communication between the Raspberry Pi and the mobile app through the Azure IoT Hub.
    - Use Azure Key Vault for managing secrets and connection strings securely.

6. Testing and Deployment:
    - Test the integration of the Raspberry Pi with the mobile app using tools like Azure IoT Explorer.
    - Deploy the mobile app to app stores and ensure it can communicate with the Raspberry Pi through the Azure IoT Hub.
7. Monitoring and Management:
    - Utilize Azure Monitor and Azure IoT Hub's monitoring features to keep track of device health and data flow.
    - Implement device management features as needed, such as updating firmware or changing configurations.
8. Scalability and Extensibility:
    - Design your solution to be scalable, considering the use of Azure services like Azure Functions, Azure Stream Analytics, and Azure Cosmos DB for data processing and storage.
    - Plan for extensibility, allowing for the addition of new features or devices as your IoT solution grows.