

DESIGN SPECIFICATION

Group 7

AUDIENCE

This design specification is intended for the SmartPonics software engineering team for building an iOS application.

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BACKGROUND

Most people living in apartments have unsuccessful plant growing experiences because they might lack the time, knowledge or environment to successfully grow ornamental, vegetative and floral plantae.

DESIGN QUESTION

How can we use technology to help apartment tenants grow plants easily?

PROJECT OVERVIEW

SmartPonics is a rooftop hydroponics garden system that can be controlled via mobile application. The hydroponic planting box is outfitted with a WiFi antenna, aquatic and total dissolved solids (TDS) sensors, water and nutrient reservoirs, pumps and planting tubes while the mobile application is installed and used to monitor and manipulate the planting box. In addition, the mobile application can also be used to buy seedlings, nutrient solutions, equipment and share the growing experience with friends. The app may also be used to contact the apartment manager or the expert when need help. This specification includes details for the design of the mobile application (on iOS) and an introduction of the hardware.

PROJECT SCOPE

In Scope

Platform: iOS platform

Features:

- Login to the application
- Choose box
- Change nutrient mode
- Change system mode
- Read key parameters (weather, nutrient, video, statistics)
- Deal with problem
- Buy seedlings, nutrient solutions, and equipment
- Ask expert for help
- Share to friends
- See medals earned
- See transaction history
- Change payment method
- Change password

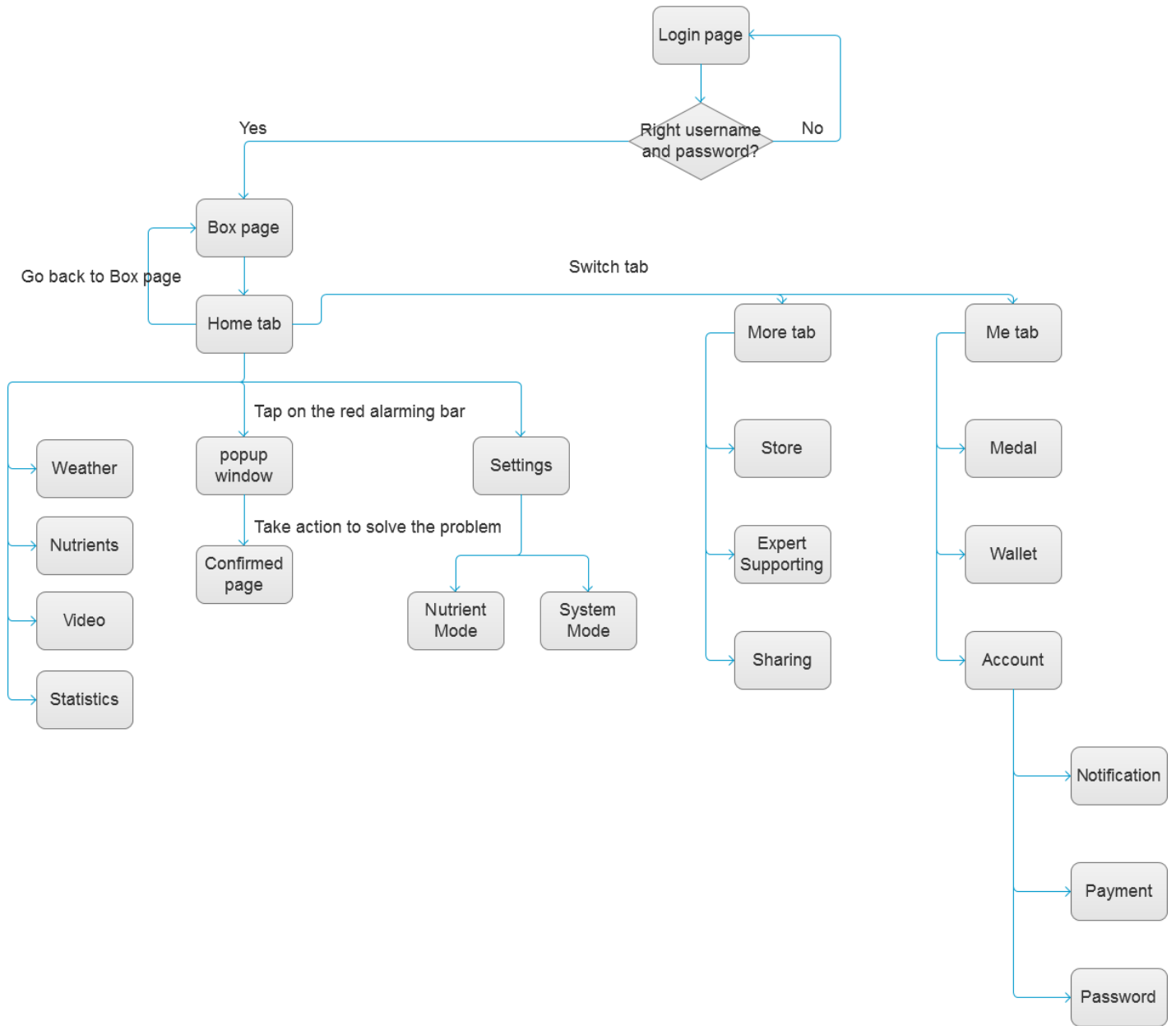
Out of Scope

Platform: Non-iOS platforms

Features:

- Setting up the hardware
- Renting the equipment

DESIGN FLOW



DESIGN SPECIFICATION

1. Login Page

On the login page, user enters the username and password assigned by the apartment manager to login.

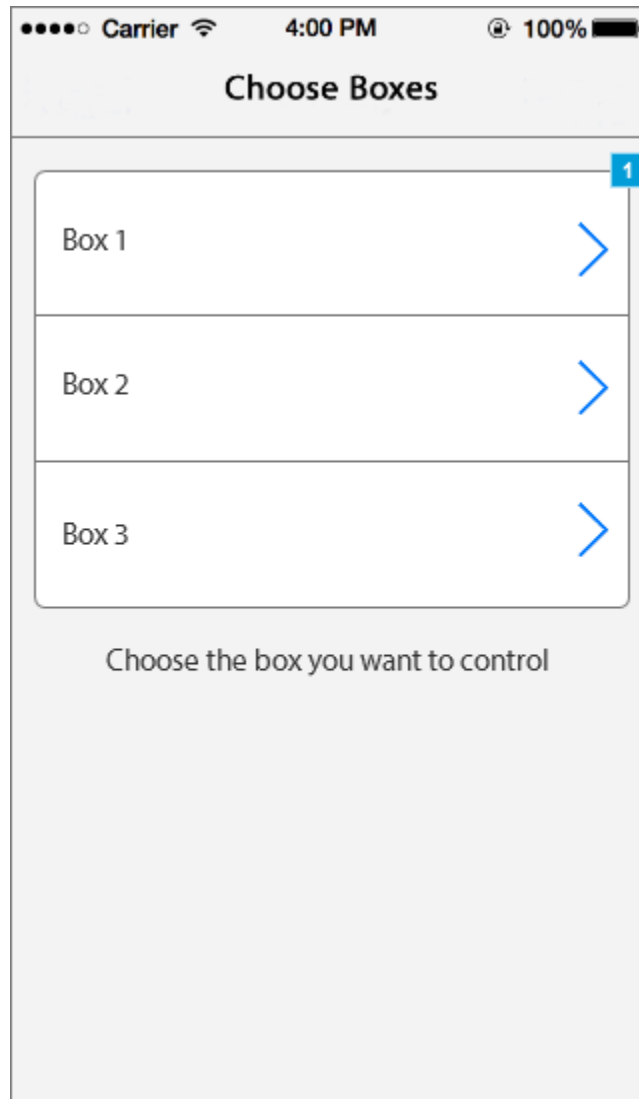


Annotations

Footnote	Label	Description
1	Login Button	On tap, with right username and password, user will successfully log into the app.

2. Choose Boxes Page

On the box page, all the planting boxes the user rents will show up. Users choose a box to see its detail information and define nutrient modes.

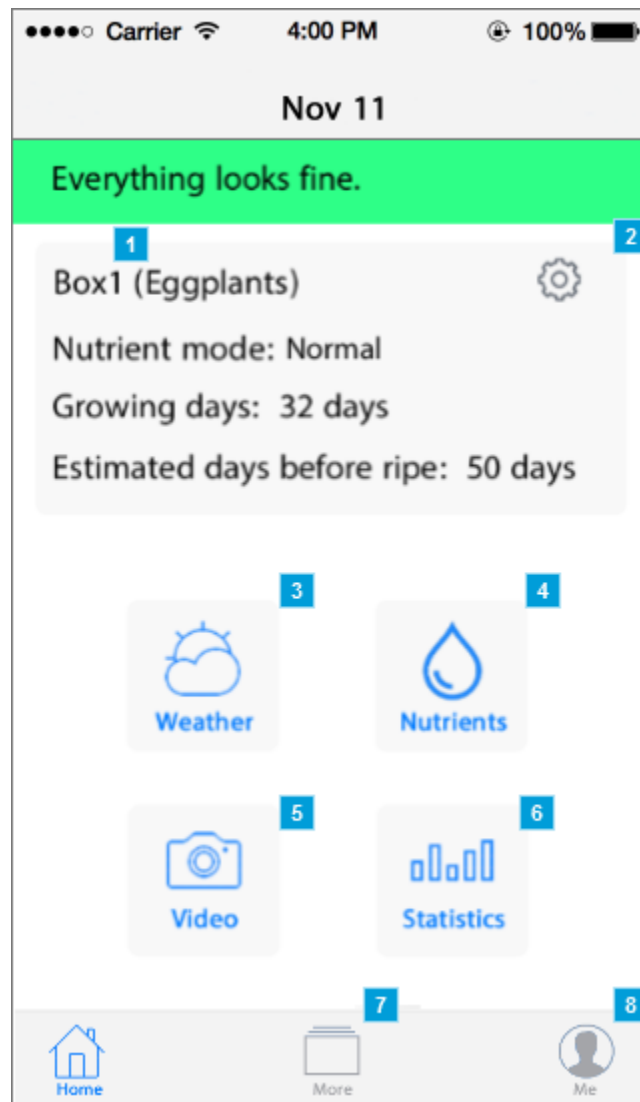


Annotations

Footnote	Label	Interactions
1	Box list	On tap, enter the box user wants to control.

3. Home Tab - Dashboard Page

On the home page, pathways to subpages are displayed as a dashboard. On the dashboard, basic information includes the status of the system, the plant's name, the nutrient mode it uses, the growing days it has, and the estimated number of days before ripening. The green bar at the top simply uses color to indicate status with additional hint text so users don't confuse the green bar as a simple aesthetic. Inversely, a red status bar with specific error messages would appear to notify users of problems with their planting box. This page also includes six entrances to box page, settings, weather, nutrients, video, and statistics.



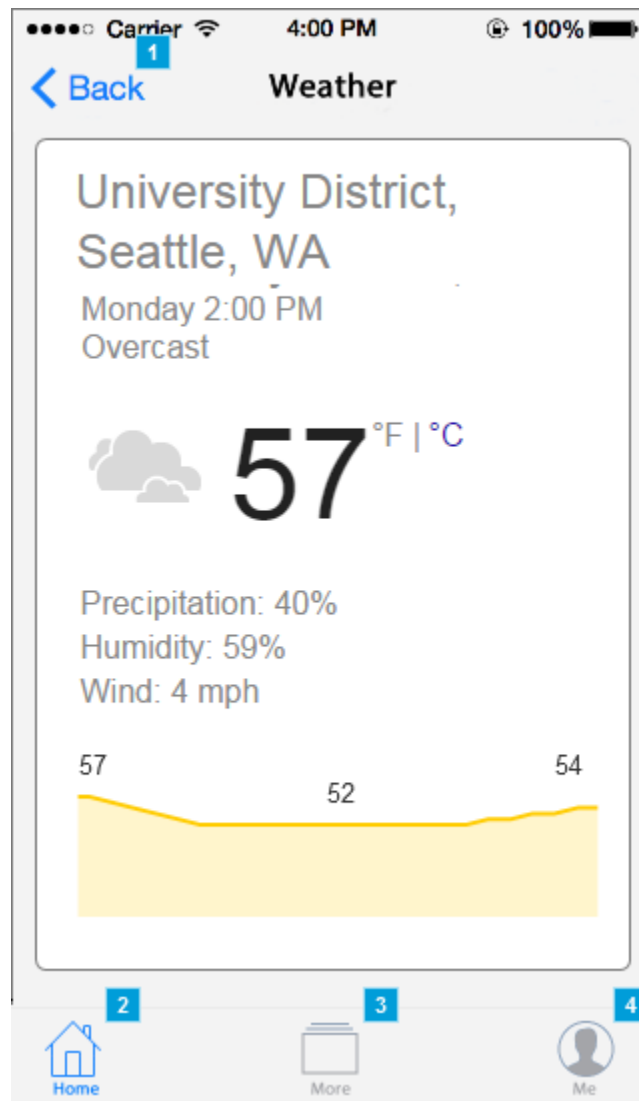
Annotations

Footnote	Label	Interactions
1	Box title	On tap, go to the box page.
2	Settings	On tap, go to the settings page of this box.
3	Weather	On tap, go to the Weather page.
4	Nutrients	On tap, go to the Nutrients page.

Footnote	Label	Interactions
5	Video	On tap, go to the Video page.
6	Statistics	On tap, go to the Statistics page.
7	More tab	On tap, switch the More tab.
8	Me tab	On tap, switch to the Me tab.

4. Home Tab - Weather Page

On the weather page, atmospheric information is displayed based on the geolocation of the plants including location, date, temperature, precipitation, humidity, and wind.

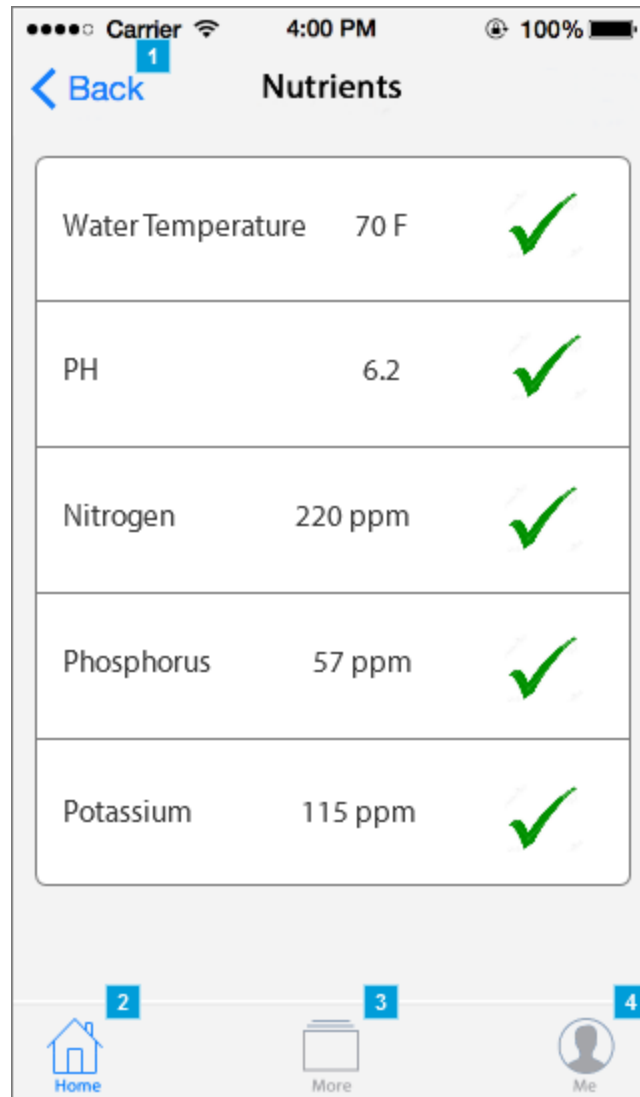


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Home tab	On tap, go back to the home page of the Home tab.
3	More tab	On tap, switch the More tab.
4	Me tab	On tap, switch to the Me tab.

5. Home Tab - Nutrients Page

The Nutrients page displays information related solution concentrations of Nitrogen, Phosphorus, and Potassium, together with the water temperature, and pH level. Green check marks indicate concentration levels within an acceptable range for the plant's growth. This information can be shared with expert support services if growth problems arise.



Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Home tab	On tap, go back to the home page of the Home tab.
3	More tab	On tap, switch the More tab.
4	Me tab	On tap, switch to the Me tab.

6. Home Tab - Video Page

On this video page, user can see the plants through a camera.

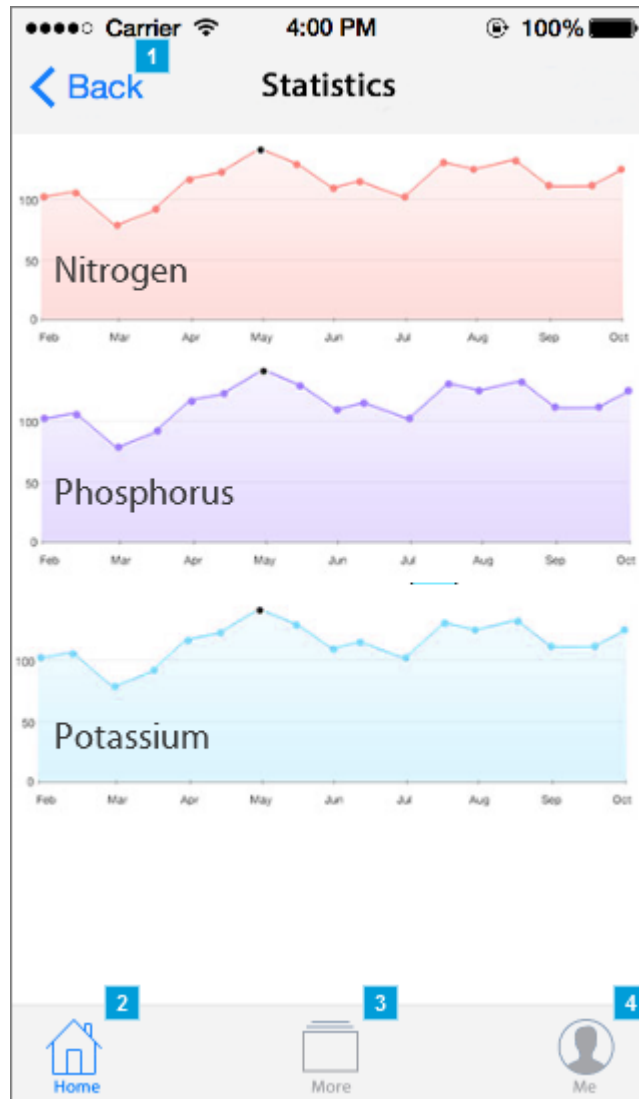


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Home tab	On tap, go back to the home page of the Home tab.
3	More tab	On tap, switch the More tab.
4	Me tab	On tap, switch to the Me tab.

7. Home Tab - Statistics Page

On this page, the statistics of all the key nutrients will show. Users can see the trend of the solution concentration of each key nutrient. This information could be shared with expert support services.

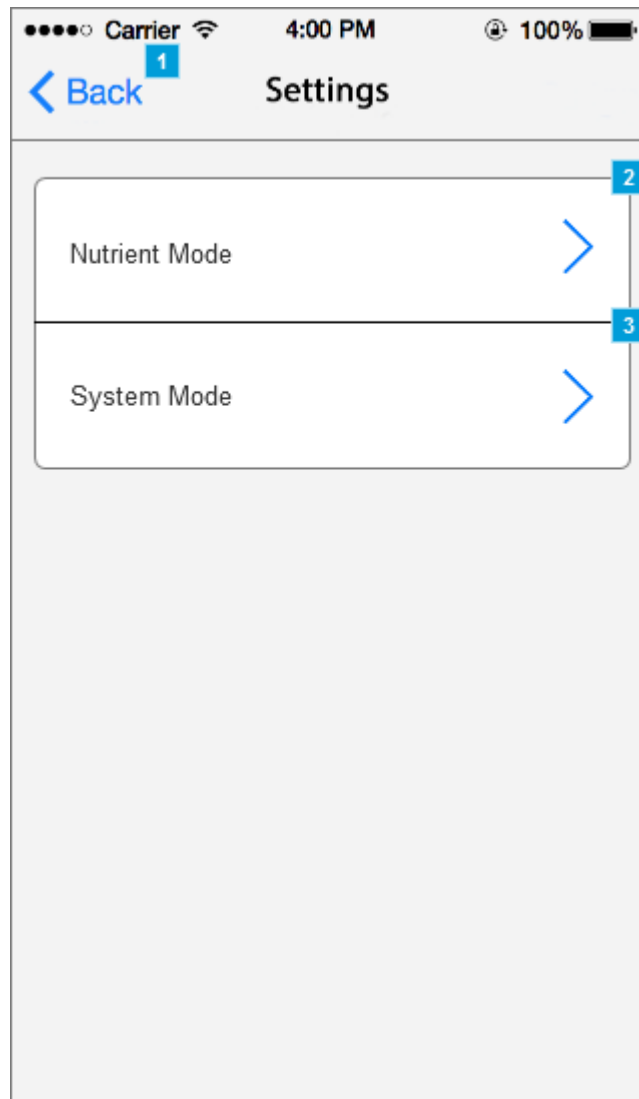


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Home tab	On tap, go back to the home page of the Home tab.
3	More tab	On tap, switch to the More tab.
4	Me tab	On tap, switch to the Me tab.

8. Home Tab - Settings Page

On this page, general settings can be viewed and modified for nutrient modes, pairing and automation.

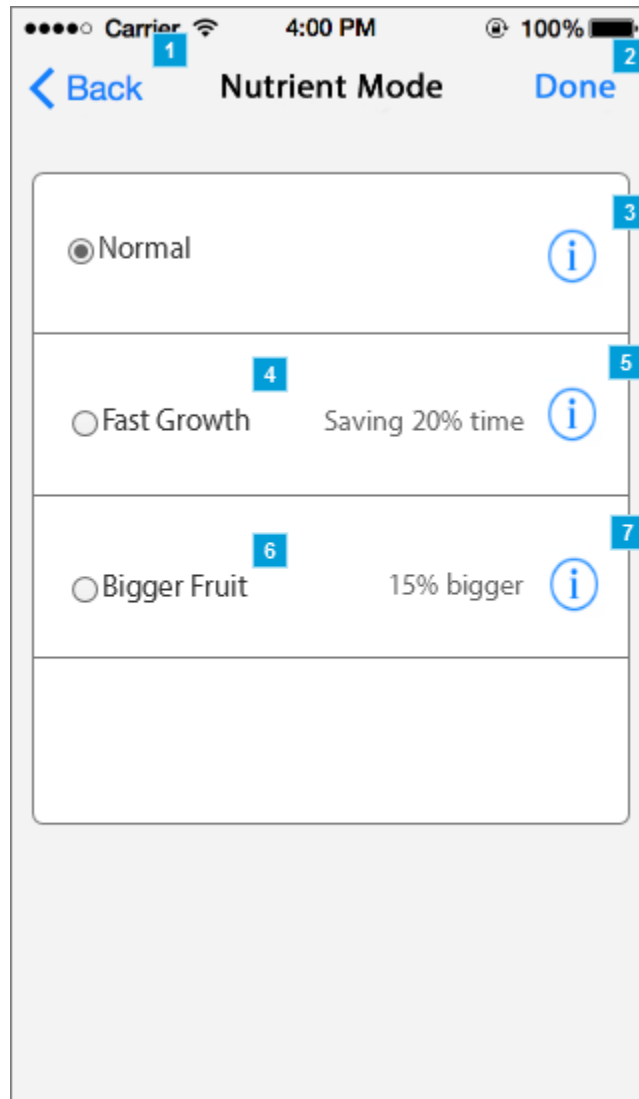


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Nutrient Mode	On tap, go to the Nutrient Mode page.
3	System Mode	On tap, go to the System Mode page.

9. Home Tab – Settings Page - Nutrient Mode Page

On this page, users can change the nutrient mode if needed. For example, users can opt for nutrient levels that promote either fast plant growth or bigger fruiting bodies



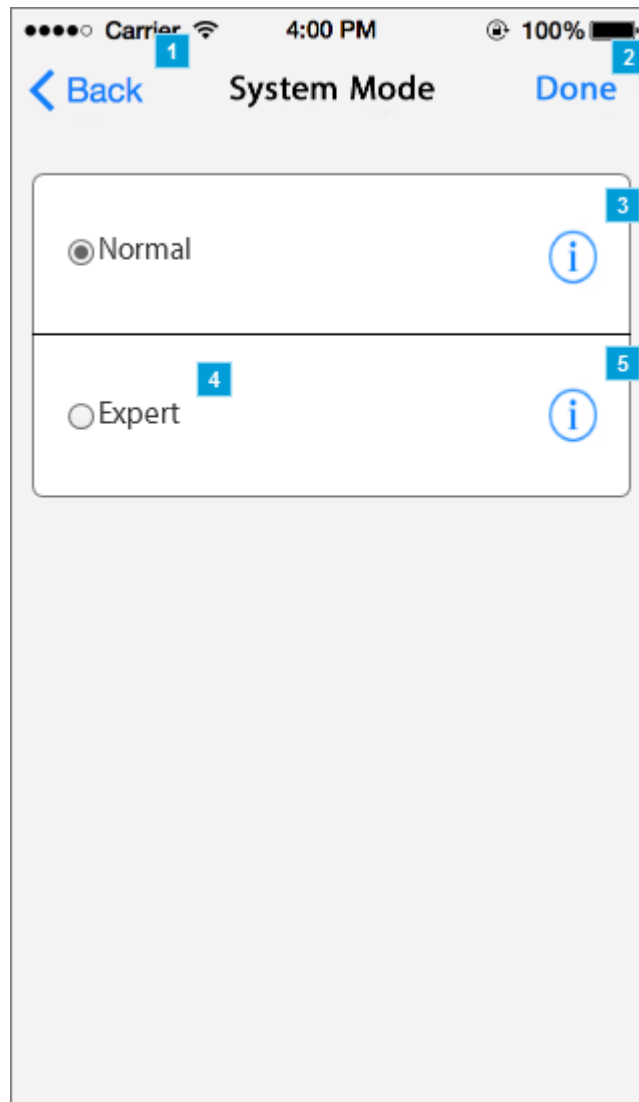
Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Done button	On tap, save the change and go to the dashboard page.
3	Normal mode information	On tap, a popup window with detail explanation of Normal mode will show up.
4	Fast Growth	On tap, switch to the Fast Growth mode.
5	Fast Growth explanation	On tap, a popup window with detail explanation of Fast Growth mode will show up.
6	Bigger Fruit	On tap, switch to the Bigger Fruit mode.

Footnote	Label	Interactions
7	Bigger Fruit explanation	On tap, a popup window with detail explanation of Bigger Fruit mode will show up.

10. Home Tab – Settings Page - System Mode Page

On this page, user could change the system mode if needed. For example, users can switch between Normal (automated) and Expert (manual) nutrient modes.

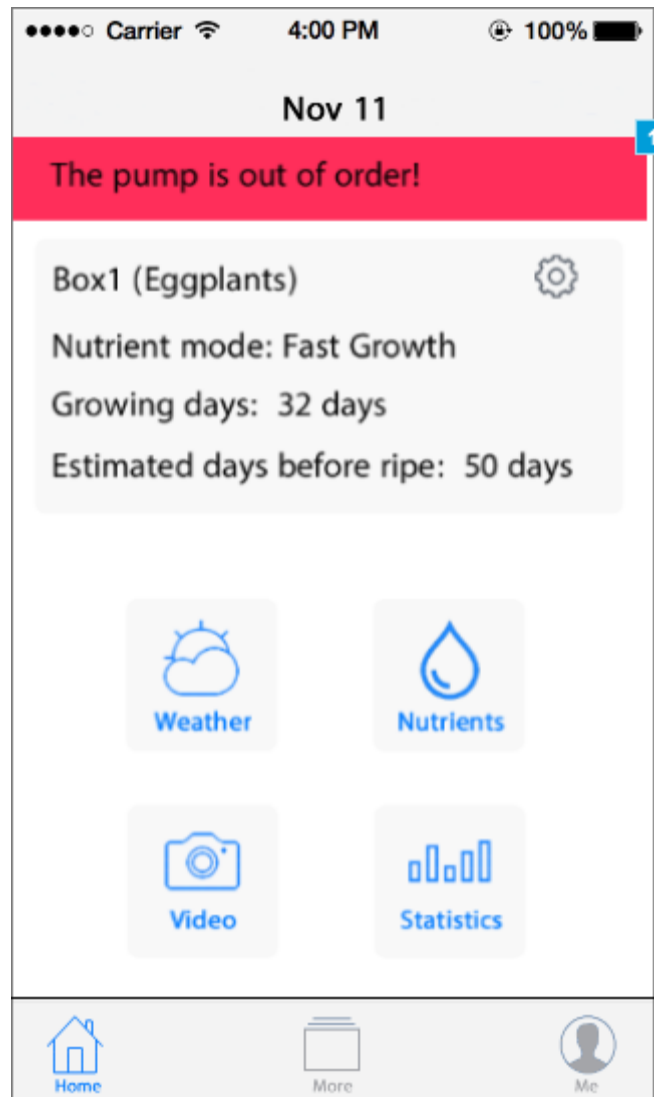


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Done button	On tap, save the change and go to the dashboard page.
3	Normal mode explanation	On tap, a popup window with detail explanation of Normal mode will show up.
4	Expert mode	On tap, switch to Expert mode.
5	Expert mode explanation	On tap, a popup window with detail explanation of Expert mode will show up.

11. Home Tab – Dashboard Page with an Alarm

On this page, a red alarming bar with a specific error indicator.

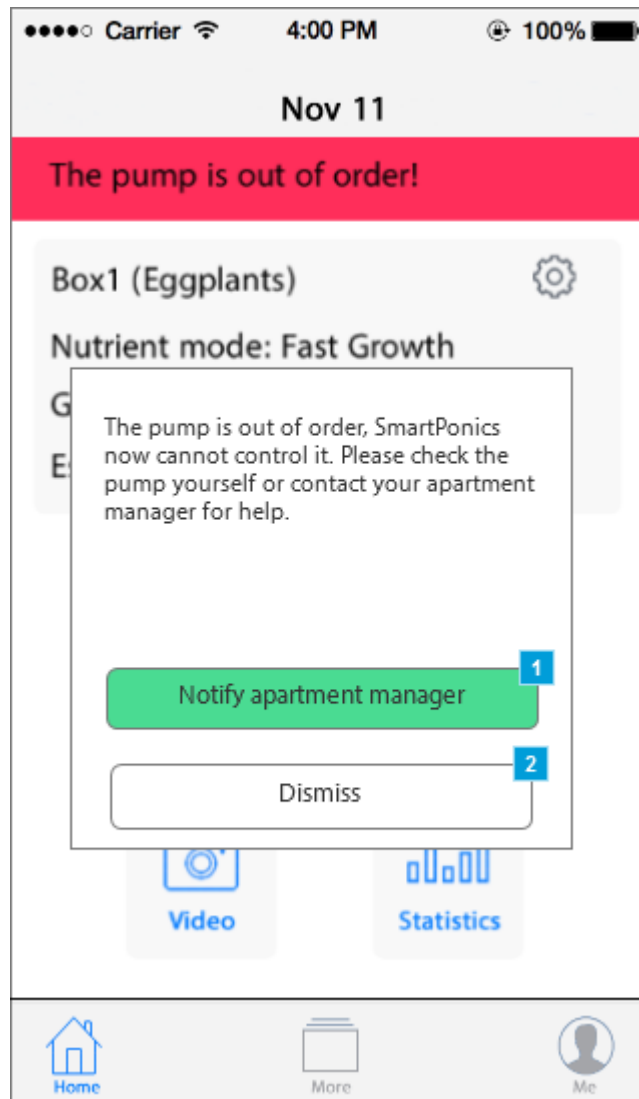


Annotations

Footnote	Label	Interactions
1	alarming bar	On tap, a window with detail information about this problem and possible actions will popup.

12. Home Tab – Dashboard Page with popup window

To resolve the error state, a popup window appears to notify the apartment manager or dismiss.

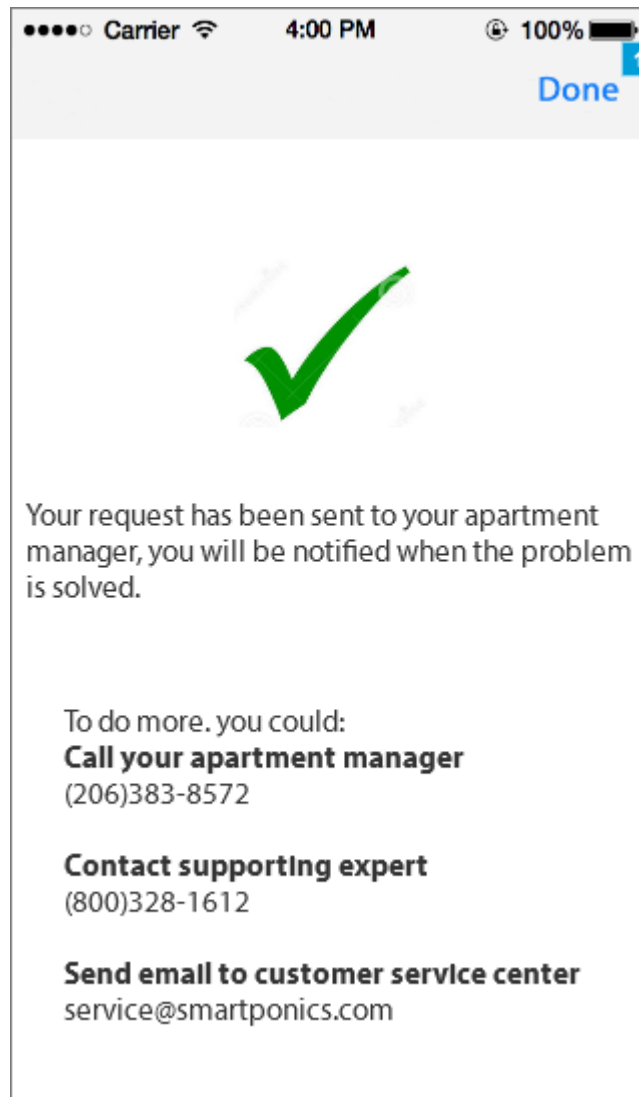


Annotations

Footnote	Label	Interactions
1	Notify button	On tap, the apartment manager will be notified of the problem.
2	Dismiss button	On tap, the popup window will be dismissed.

13. Home Tab - Confirmed Page

If “Notify apartment manager” is selected, the confirmation page below will display.

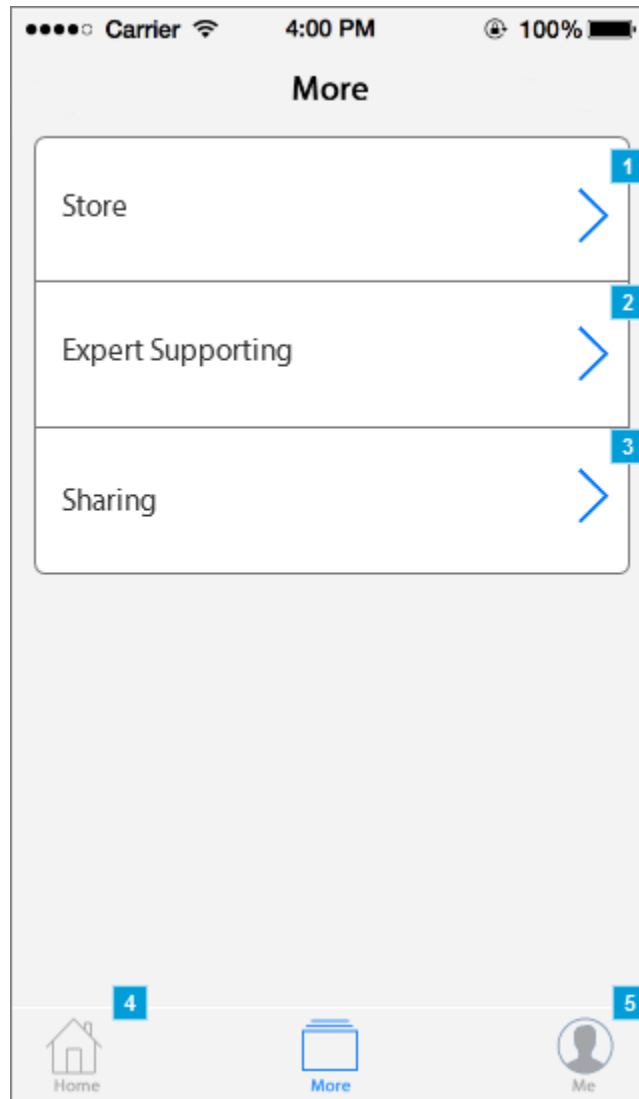


Annotations

Footnote	Label	Interactions
1	Done button	On tap, go back to the dashboard page.

14. More Tab

This page includes the extensional features that are not crucial to the system but are still valuable to offer an expanded e-commerce experience such as online store, expert supporting and sharing.

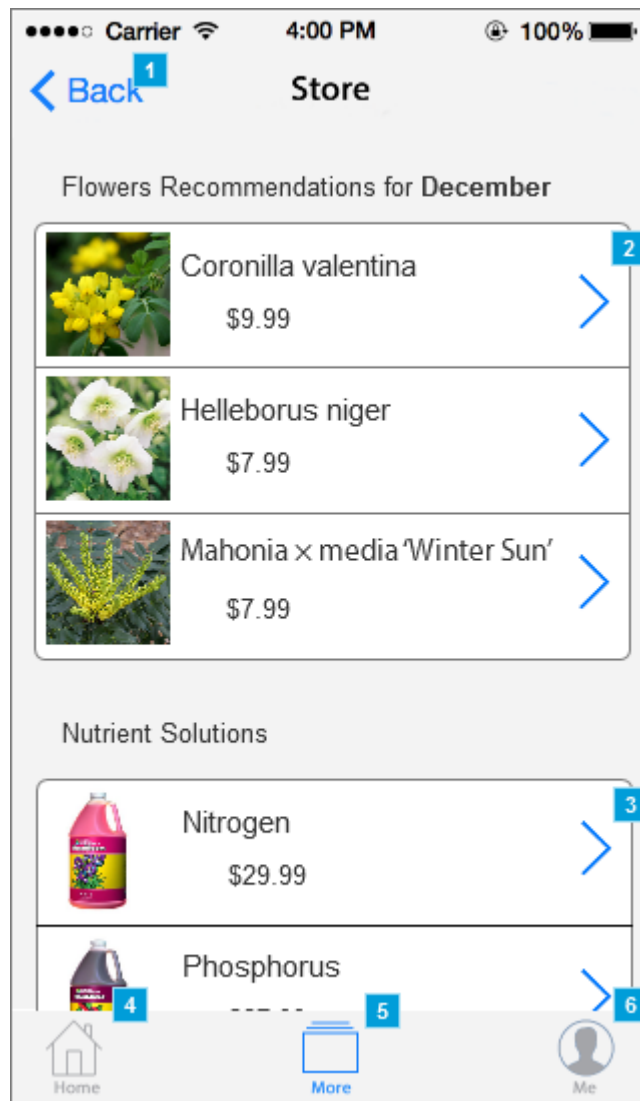


Annotations

Footnote	Label	Interactions
1	Store	On tap, go to the Store page.
2	Expert Supporting	On tap, go to the Expert Supporting page.
3	Sharing	On tap, go to the Sharing page.
4	Home tab	On tap, switch to the Home tab.
5	Me tab	On tap, switch to the Me tab.

15. More Tab - Store Page

On this page, users can buy flower seedlings, vegetable seedlings, and fruit seedlings. Nutrient solutions and equipment can also be purchased here.

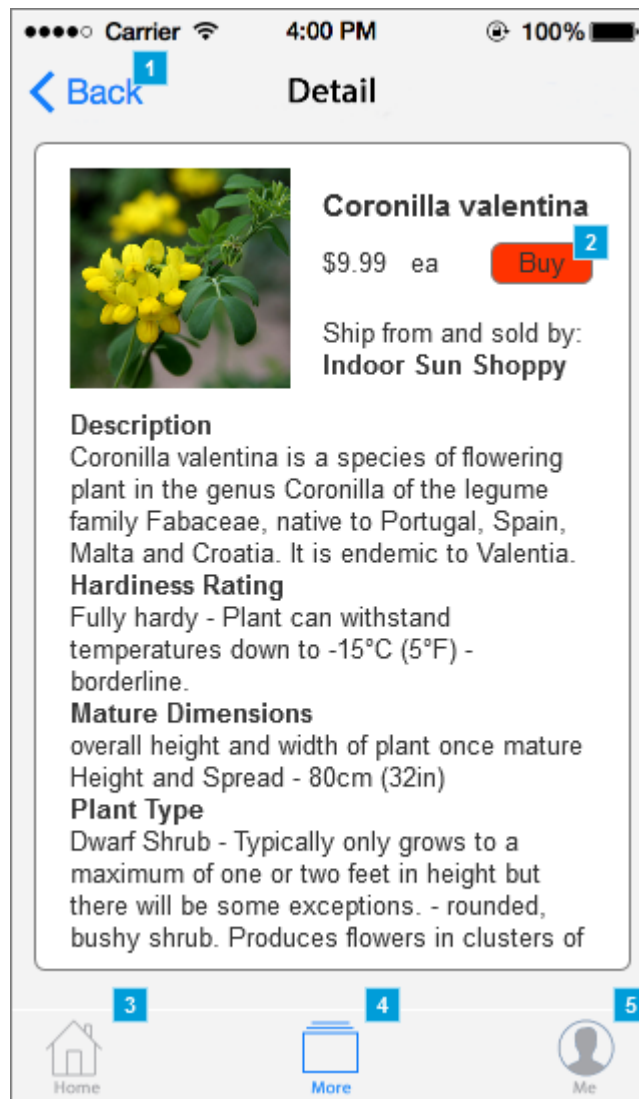


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Detail page	On tap, go to the detail information if this flower.
3	Detail page	On tap, go to the detail information if this nutrient solution.
4	Home tab	On tap, switch to the Home tab.
5	More tab	On tap, switch to the More tab.
6	Me tab	On tap, switch to the Me tab.

16. More Tab - Store Detail Page

On this page, detail of this selected product (might be flowers, plants, fruits, nutrient solutions, or equipment) will show. User could read the descriptions and buy if needed.

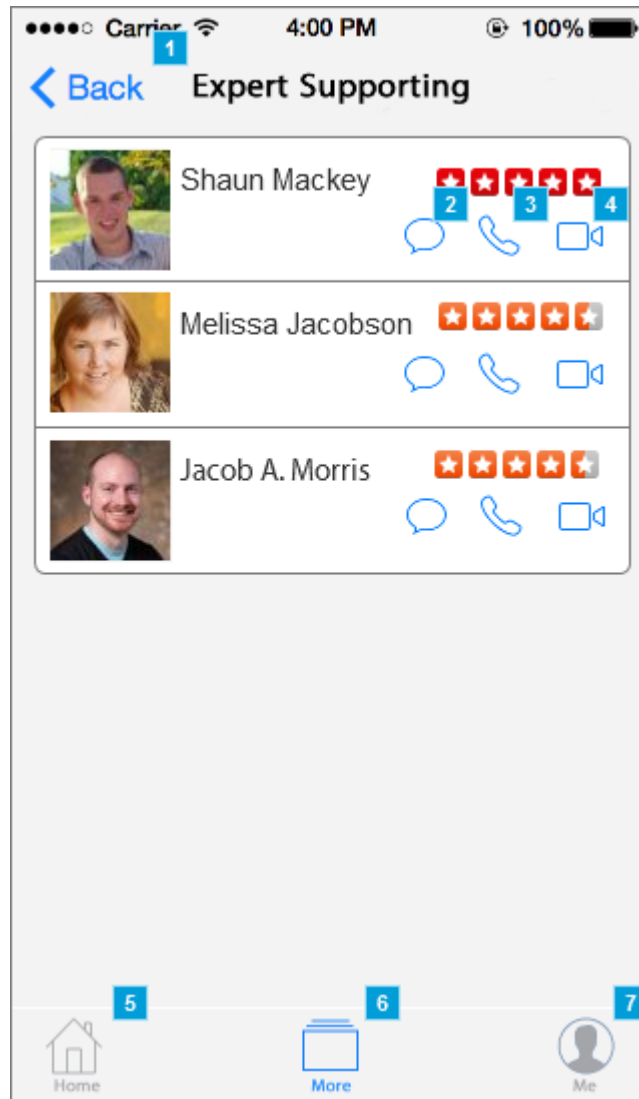


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Buy button	On tap, go to the checkout page.
3	Home tab	On tap, switch to the Home tab.
4	More tab	On tap, switch to the More tab.
5	Me tab	On tap, switch to the Me tab.

17. More Tab - Expert Supporting Page

On this page, users can contact an expert for help with any phase of the growth process. Experts are sorted and listed according to ratings. Users can either send an IM, make a call, or video meeting.

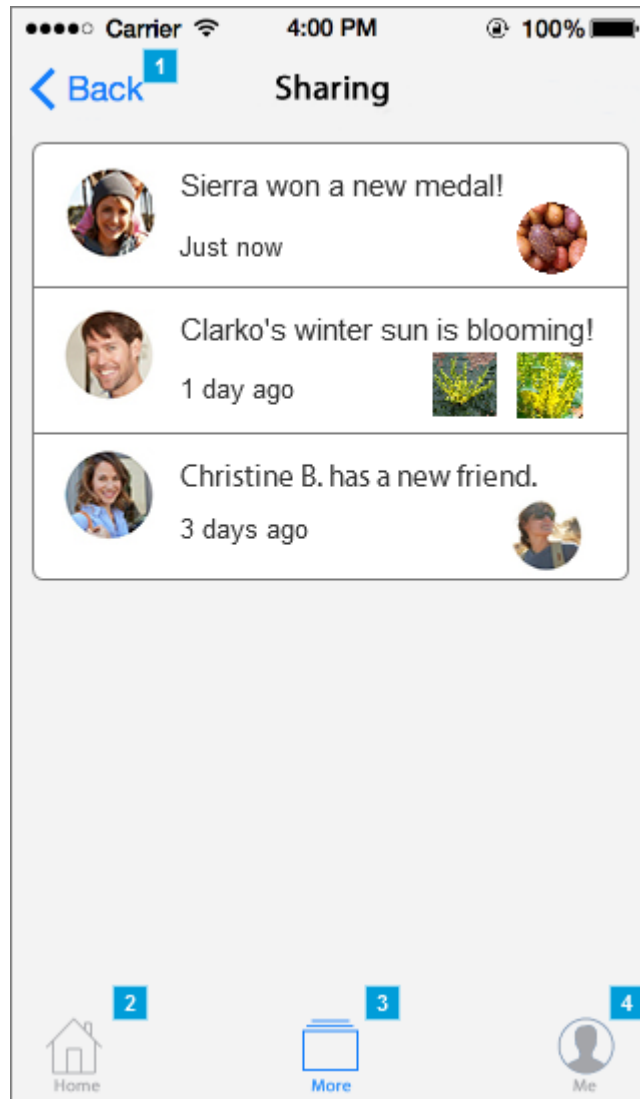


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	IM button	On tap, send an IM to this expert.
3	Call button	On tap, call this expert.
4	Video button	On tap, make a video call to this expert.
5	Home tab	On tap, switch to the Home tab.
6	More tab	On tap, switch to the More tab.
7	Me tab	On tap, switch to the Me tab.

18. More Tab - Sharing Page

On this page, users can see a scrolling status feed, displaying the growth statuses, ripening estimates and awards won by a user's friends.

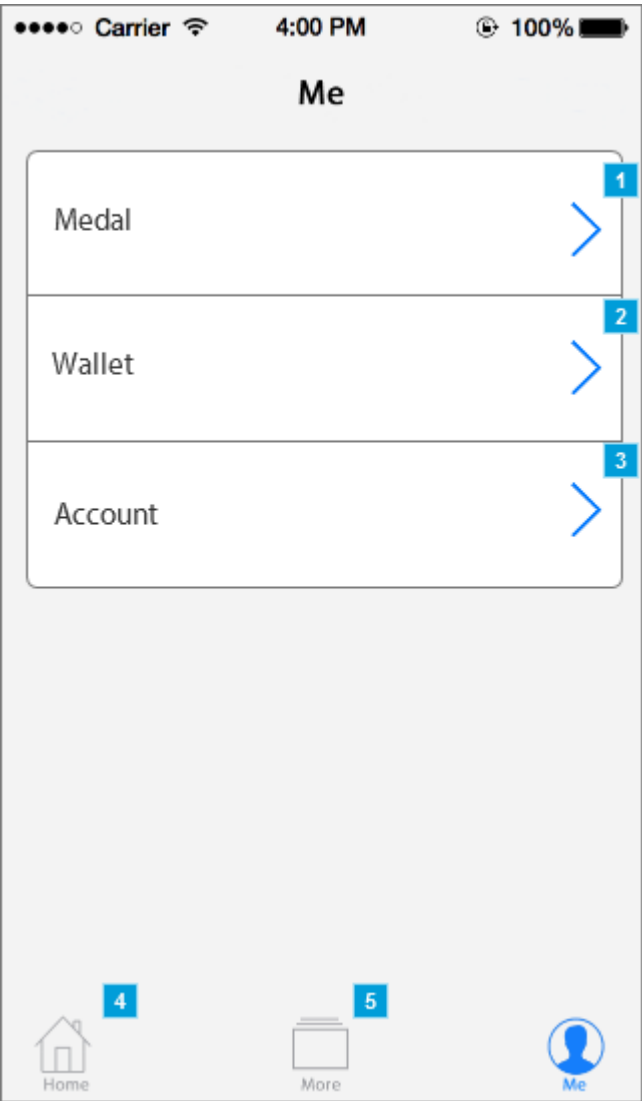


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Home tab	On tap, switch to the Home tab.
3	More tab	On tap, switch to the More tab.
4	Me tab	On tap, switch to the Me tab.

19. Me Tab

On this page, the user’s account information, such as wallet, medals, and general account settings can be accessed.

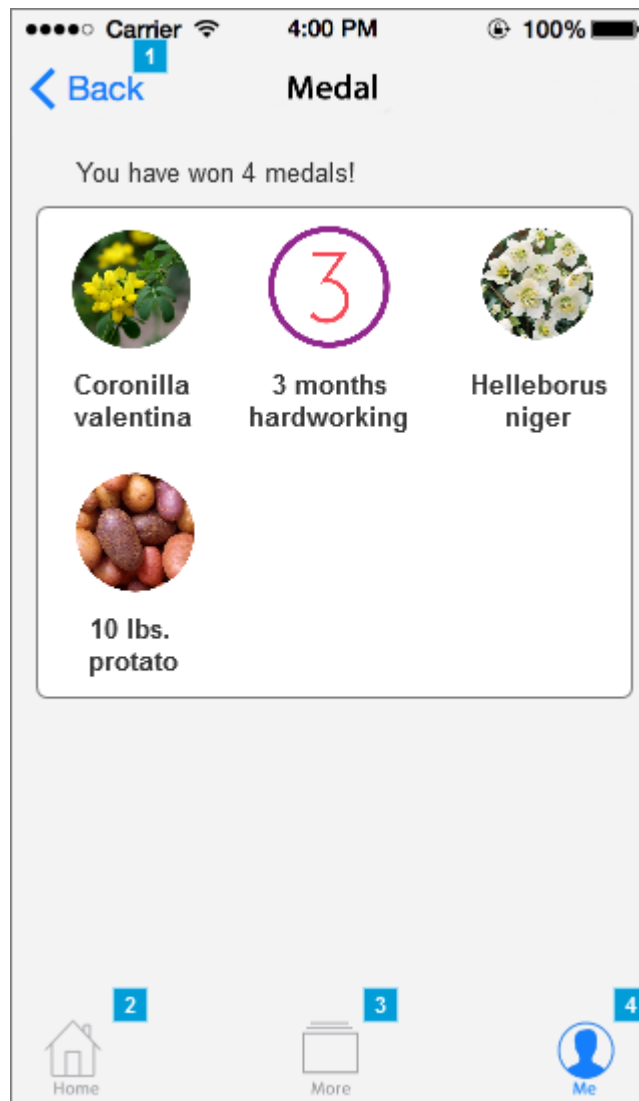


Annotations

Footnote	Label	Interactions
1	Medal	On tap, go to the Medal page.
2	Wallet	On tap, go to the Wallet page.
3	Account	On tap, go to the Account page.
4	Home tab	On tap, switch to the Home tab.
5	Me tab	On tap, switch to the Me tab.

20. Me Tab - Medal Page

On this page, users can see their Medal collection. Medals can be seen by or hidden from friends in Settings.

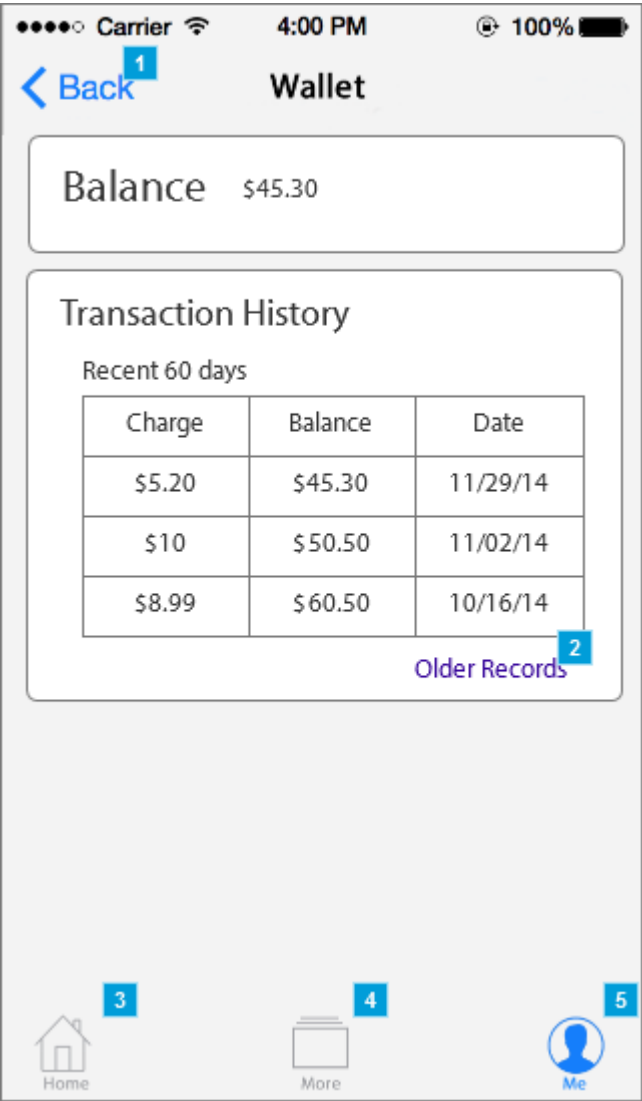


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Home tab	On tap, switch to the Home tab.
3	More tab	On tap, switch to the More tab.
4	Me tab	On tap, switch to the Me tab.

21. Me Tab - Wallet Page

On this page, users can see the balance and transaction history.

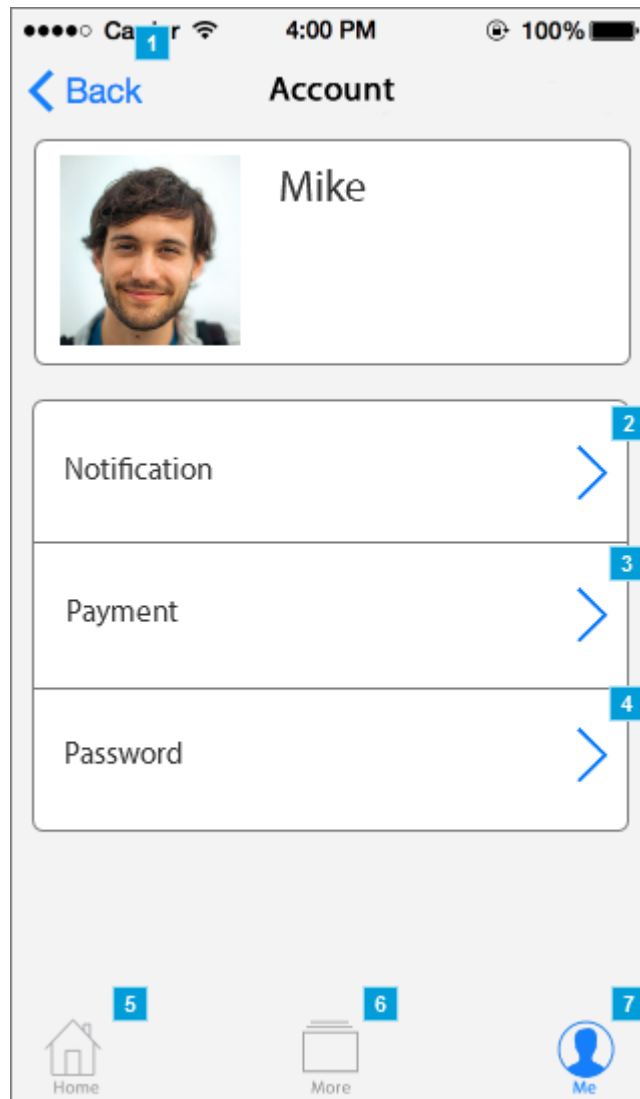


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Older Records	On tap, go to older records page.
3	Home tab	On tap, switch to the Home tab.
4	More tab	On tap, switch to the More tab.
5	Me tab	On tap, switch to the Me tab.

22. Me Tab - Account Page

On this page, users can access and edit their account information.

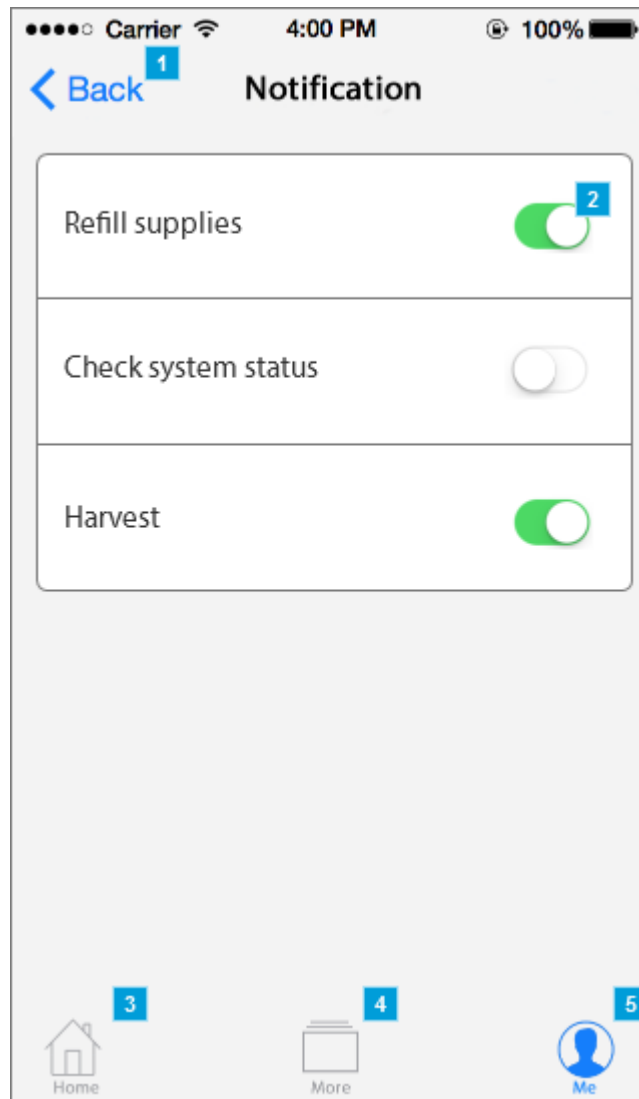


Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Notification	On tap, go to the Notification page.
3	Payment	On tap, go to the Payment page.
4	Password	On tap, go to the Password page.
5	Home tab	On tap, switch to the Home tab.
6	More tab	On tap, switch to the More tab.
7	Me tab	On tap, switch to the Me tab.

23. Me Tab – Account Page - Notification Page

On this page, users can control which push notifications they want to see.



Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Switch	On tap, turn off the switch.
3	Home tab	On tap, switch to the Home tab.
4	More tab	On tap, switch to the More tab.
5	Me tab	On tap, switch to the Me tab.

24. Me Tab – Account Page - Payment Page

On this page, users can view, add, or remove credit cards connected to the SmartPonics.



Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Credit card	On tap, user could view the detail of this credit card, also remove this credit card if needed.
3	Home tab	On tap, switch to the Home tab.
4	More tab	On tap, switch to the More tab.
5	Me tab	On tap, switch to the Me tab.

25. Me Tab – Account Page - Password Page

On this page, users can change their access password.

The screenshot shows a mobile app interface for changing a password. At the top, the status bar displays 'Carrier', '4:00 PM', and '100%' battery. The app header includes a blue back arrow labeled '1', the title 'Passwords', and a blue 'Done' button labeled '2'. The main content area contains three text input fields: 'Current Password', 'New Password', and 'Reenter New Password'. At the bottom, the tab bar features three icons: a house icon labeled '3' (Home), a folder icon labeled '4' (More), and a person icon labeled '5' (Me).

Annotations

Footnote	Label	Interactions
1	Back button	On tap, go back to the previous page.
2	Done button	On tap, new password will be saved.
3	Home tab	On tap, switch to the Home tab.
4	More tab	On tap, switch to the More tab.
5	Me tab	On tap, switch to the Me tab.

DESIGN DECISIONS AND RATIONALE

Since SmartPonics is composed both of hardware and software, we gathered data from primary and secondary users via seven research methods including surveys (there were 86 participants), interviews, competitive analysis, secondary research and field investigation to determine how the look and feel of interacting with SmartPonics would be composed. Here's a design rationale tour of the mobile application and hardware:

Mobile Application

1. Novice-Friendly

Based on survey data, most of our users are gardening amateurs who lack professional knowledge in growing plants. For this reason, it made more sense for the design to offer automated monitoring and environmental controls since the vast majority of users would be hesitant to modify nutrition levels without knowing the implications.

The nutrient page might be the most technically-challenging page in the application, since the pH and concentration values of the solution are shown. As such, the design uses green check marks to indicate that the numerical values are within an acceptable range for plant growth.

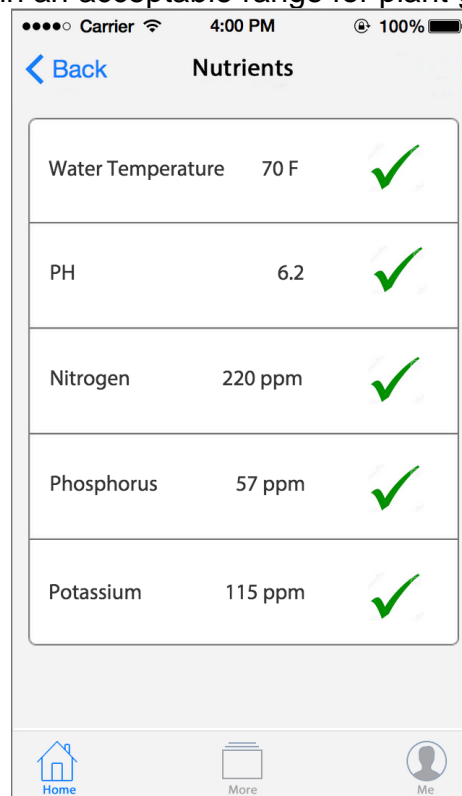


Figure 1

2. Mode Control

Hydroponics uses liquid nutrients to feed plants, and can require very detailed adjustments to nutrient levels in order to procure a particular growth outcome. Generally, detailed nutrient adjustment falls within the expert user category, but we wanted the design to be accessible to amateur plant growers as well – many of whom do not have hydroponic experience.

So, instead of dichotomizing the app to cater to the expert OR amateur user group, we created settings for both where the experts would be able to manipulate water and nutrient levels and the amateurs would let the SmartPonics planter box sensors and actuators regulate water levels and total dissolved solids (nutrients). The default mode is the Normal mode (automated monitoring) since our research suggests that most users will be plant enthusiasts and novice growers. Figure 2 shows the system mode selection page where user could switch the system mode:

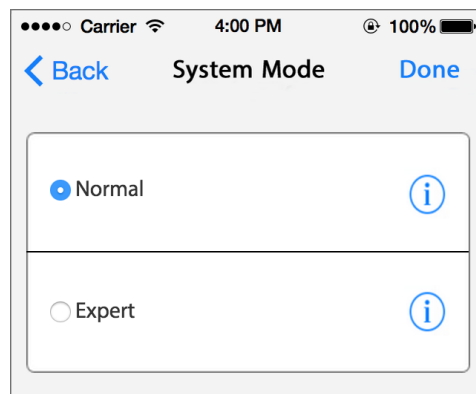


Figure 2

In the Normal mode, basically the system takes care of everything. In the Expert mode, in contrast, users can manipulate watering and nutrient solution levels at will.

3. Little Time Required

Our pre-research design would have required users to check their phone multiple times per day to water their plants and adjust dissolved nutrients. It would have burdened the majority of our users. For example, from the survey we know that time shortage is a main preventative from growing plants, as is shown in Figure 3.

To answer the need for quick updates, we added highly visible status bars on the dashboard page to give an overall system pulse shown in Figure 4. Again, in the design of this status bar, we use colors to encode two different statuses. Aside from the status bar, the dashboard also includes the basic information of the primary plant, such as plant's name, nutrient mode used, days of growing, and estimate days before ripening.

What is currently preventing you from growing plants?

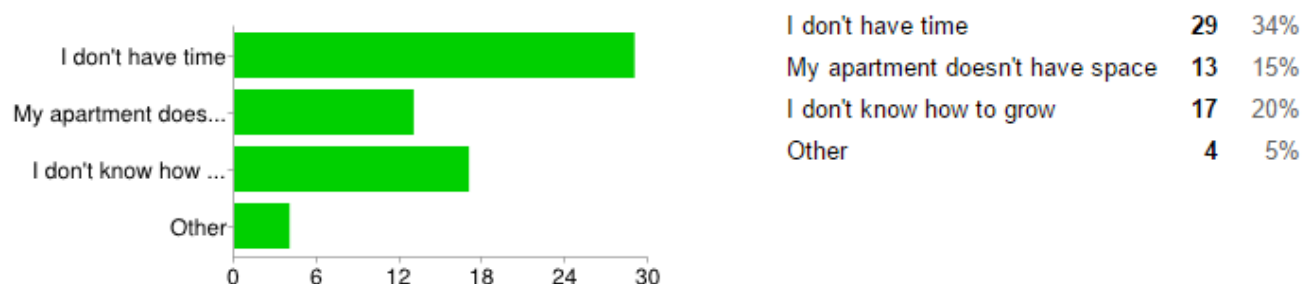


Figure 3

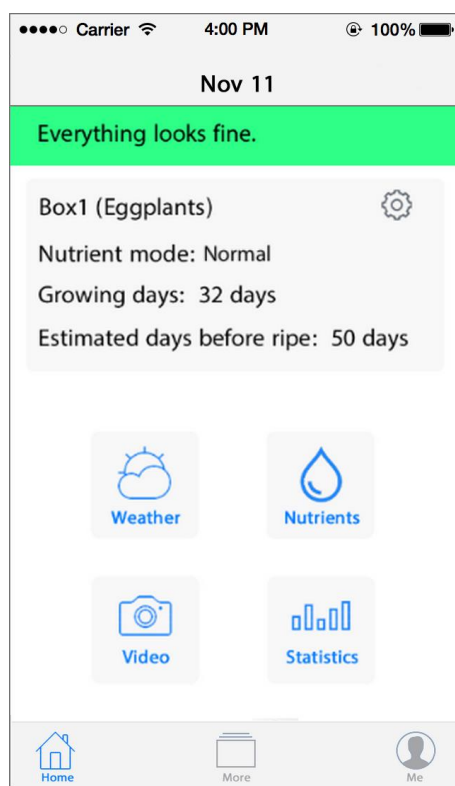


Figure 4

4. Involvement

We foresaw a potential problem keeping users who opted for Normal mode engaged since Normal mode essentially sets the growth system to autopilot. As such, we thought about gamifying the experience for all users, to increase engagement. Now, users can earn medals and share their planter's status with friends. Figure 5 exemplifies a user's medals.

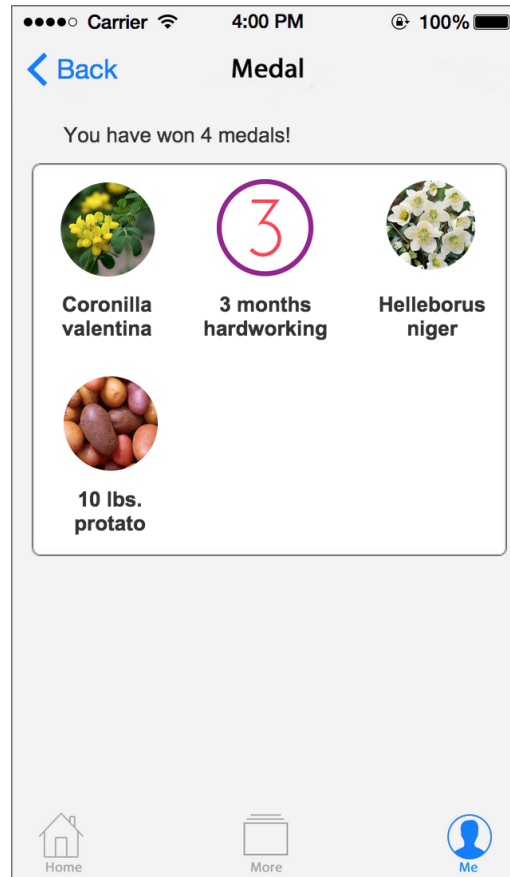


Figure 5

Hardware

1. Hydroponics

The hydroponic planting box is a crucial element in the design and took the most time to develop. We weighed the pros and cons of using hydroponics as opposed to dirt based mediums, and came up with the following:

- Hydroponics would weigh less and be more suitable for rooftops
- Hydroponics yield higher and quicker growth which we can assume to include increased user participation
- Hydroponics can help grow more plants in less space
- Hydroponic plants have a higher pest resistance
- Hydroponics is also preferable for growing vegetables, and based on our data participants would be highly likely to use such a system for growing edible plants

User interviews with apartment managers confirmed that this lightweight, retractable design was ideal for setup, storage and rooftop weight safety.

2. Rooftop Garden

We decide to put the hydroponics on the rooftop because, based on the survey, the most popular problem users met when growing plants in the apartments is the lack of sunlight, as is shown in Figure 6, and placing the hydroponics on the rooftop is the best way answer that problem. Using artificial lights could also work for buildings with high voltage power supplies and overhangs to hang the lights from.

Have your plants encounter any of the following problems?

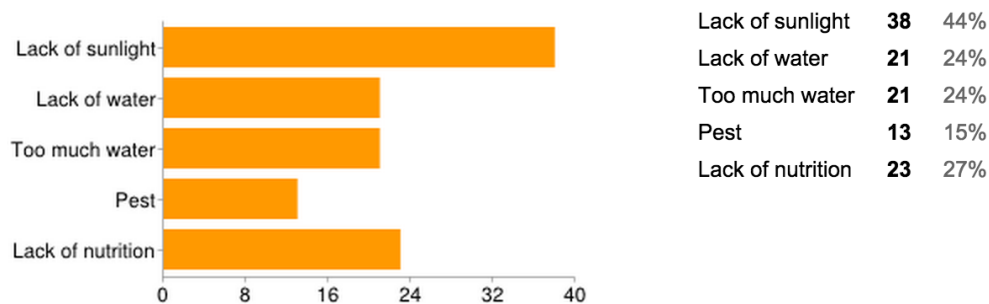


Figure 6

3. Accordion Design

The user interviews with apartment managers confirmed that all they want is portable, lightweight, easy to setup and maintain rooftop gardens.

After thorough brainstorming we had to come up with a design that can be easily transported from the warehouse to the apartment and also from the ground floor to the roof. So, we build this accordion model so that the model when unused doesn't take much space and so can be easily transported between locations. Figure 7 shows the contracted and expanded view.



Figure 7

4. Multiple Vial Holders

Originally, we came up with a huge glass plate that can hold the plants so that maintaining the plants especially during the crop changes is extremely easy. But we noticed it takes significant amount of effort to lift the glass from its position. So, we came up with this current design of multiple seedling vial holders which makes it easy to maintain the product during crop/plant changes. Also the vial holders can be put back into the hardware box when not in use.

5. Double Compartments

The biggest challenge people faced with the initial design was there is no proper water disposal option included. The users were hesitant to let the used nutrient water into drains as they believed it might not be right to mix this water with their normally disposed water. The current design of two compartments addresses this issue by draining the used water into the second compartment and then evaporating the water using heaters. The remained collected nutrient powder can be disposed safely with the compost waste.

6. Network Connectivity

The device comes with an in-built 4G SIM slot so that the device picks up the signal on the rooftop. This design decision is based on the fact that most of the rooftops do not have ethernet access.

7. Replaceable Layer

The nutrients which are organic in nature form an organic sediment on the container sides and the bottom of the planter. The process of cleaning this takes a lot of effort on the user's part. But our user personas have a very little time to maintain this garden. We came up with many ideas on how to clean this. We envisioned multiple scrubbers moving on all directions by using Hydrogen peroxide to clean this organic waste but we found the current solution of disposable later much effective. The current design has a layer inside the container and all the sediment formed on the layer can be easily removed by changing the layer. The layer is biodegradable and so it doesn't violate the very purpose of this entire product of making earth greener.

8. Additional accessories

The design also provides the support to install cover for the hydroponics during extreme weather condition. It also has solar cells on the top of the cover which are used to generate electricity to run this equipment.

APPENDIX

1. Google Doc Folder with All Project Documentation:
<https://drive.google.com/folderview?id=0B3ZohE4ljwhkZUFDMXpjN0ZIUKU&usp=sharing>
2. Online Prototype: <http://dlInbk7.axshare.com/>