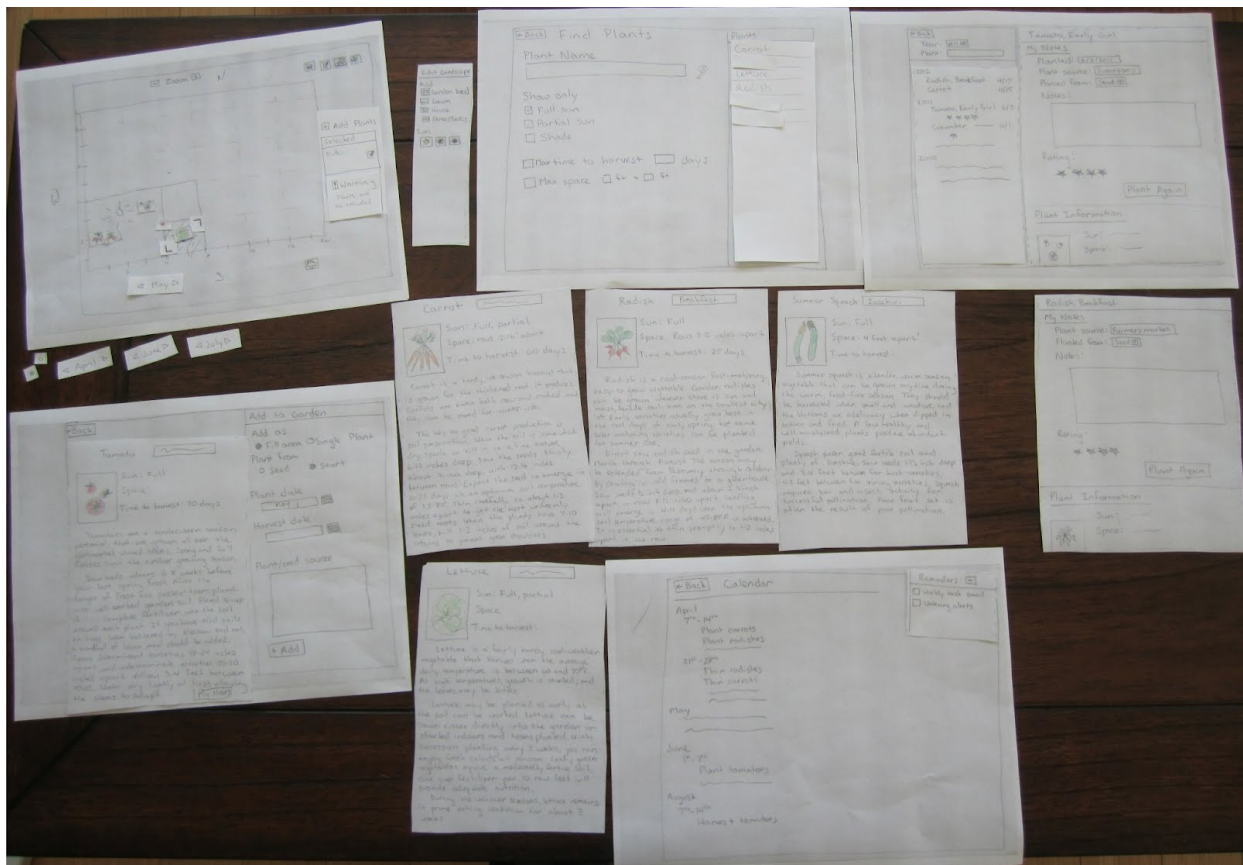


Gardenizer

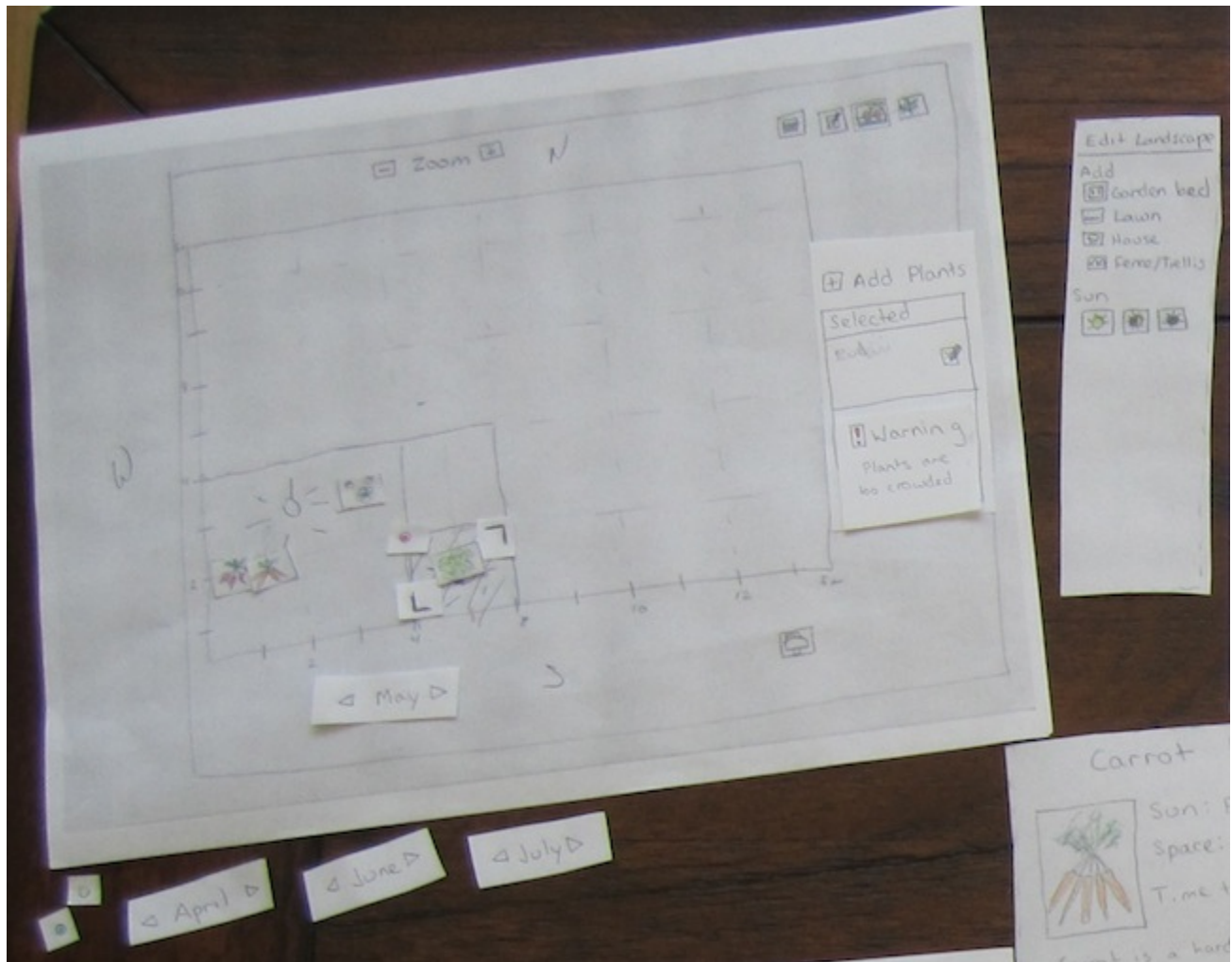
Problem and solution overview

We are attempting to solve the problem of planning highly space-efficient, multi-season gardens. While a number of garden planning applications exist, most prohibit plant overlap and assume a single plant will occupy a given space over the course of a calendar year. We intended to help gardeners in urban areas with long growing seasons (like Seattle) optimize their space usage in a smaller garden. Our plan is to provide an application to help users quickly find plants that work in their garden, to see what previous crops they've planted, and to journal how plants perform throughout the year.

Paper prototype description



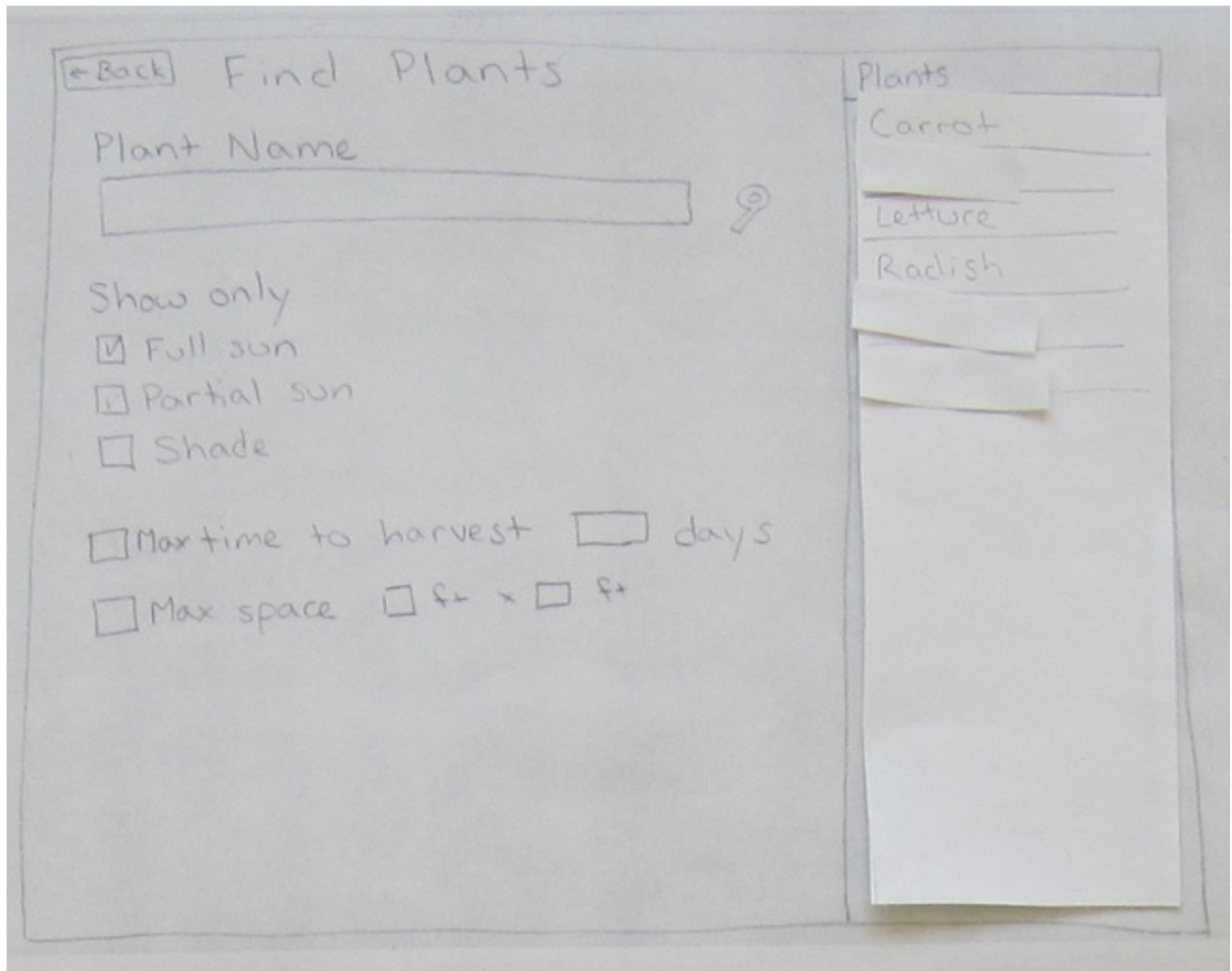
The overall paper prototype (above) consisted of full-sheet bases, with sub-panels as separate sheets.



The main garden page was the most complicated of the prototype pages. It had separate month displays for each month, with arrows to change the month, as well as a separate panel to show information for the plant being currently placed. The plant being placed was represented with a small plant token, moved around to follow the user's finger. As the plant was being moved, a small indicator token followed the "cursor" as well, showing either green, yellow, or red. This was updated along with the planting status in the plant information panel according to where the plant was being placed - OK, Caution, or Warning.

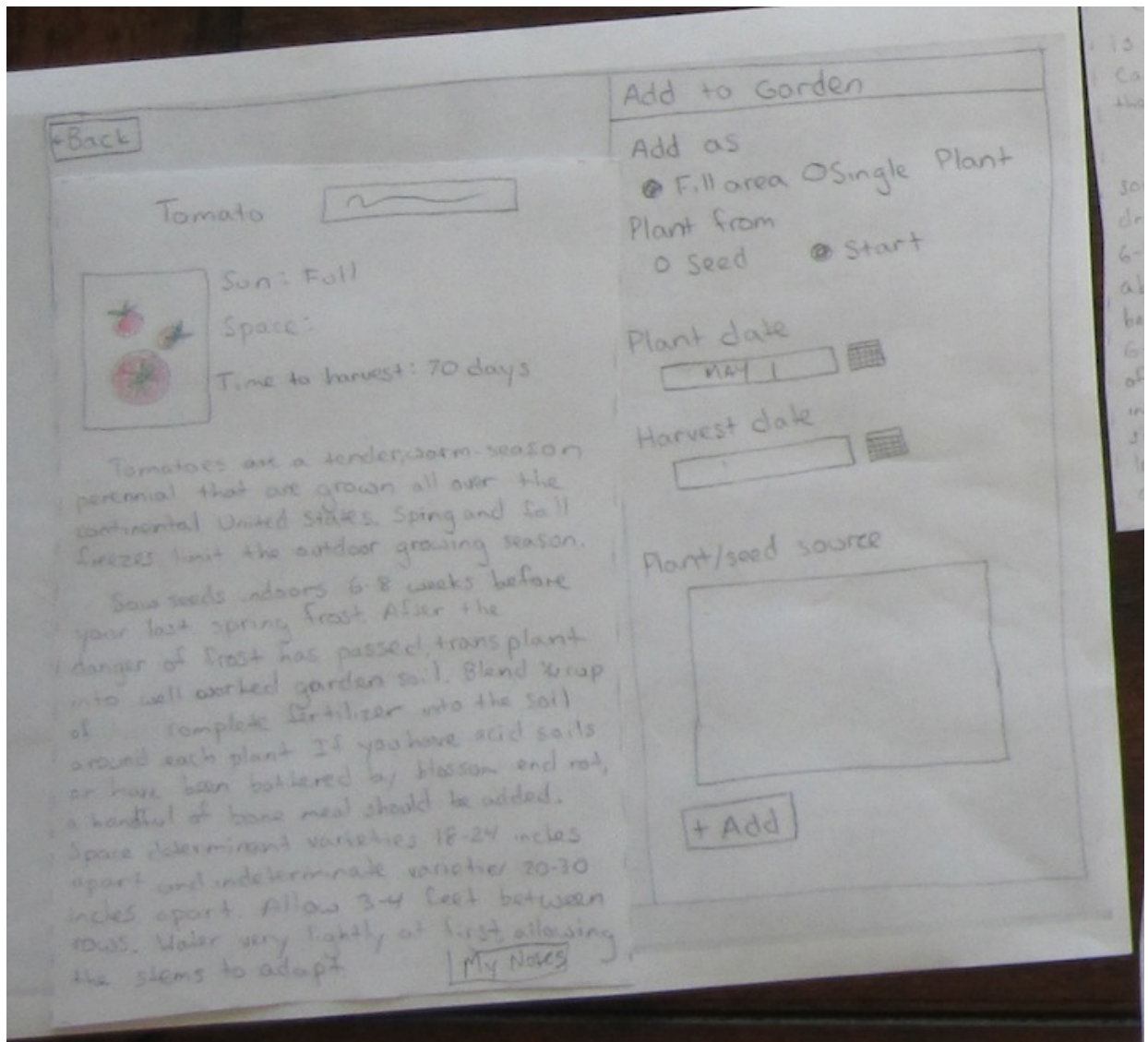
When the user selected either the planting icon (fourth from the left) or the garden layout button (third from the left), the appropriate controls were swapped in to the right-hand panel. For the garden layout controls, the user was instructed to draw in the garden as they wished. For the planting controls, the users needed to click on the "Add Plant" button to gain an active plant to put in the garden. This will swap in the "Find Plants" page.

Selecting the calendar icon (the first from the left) swaps in the "Calendar" page, and selecting the notes icon (the second from the left) swaps in the "Notes" page (pictured with "Tomato, Early Girl" at the top).



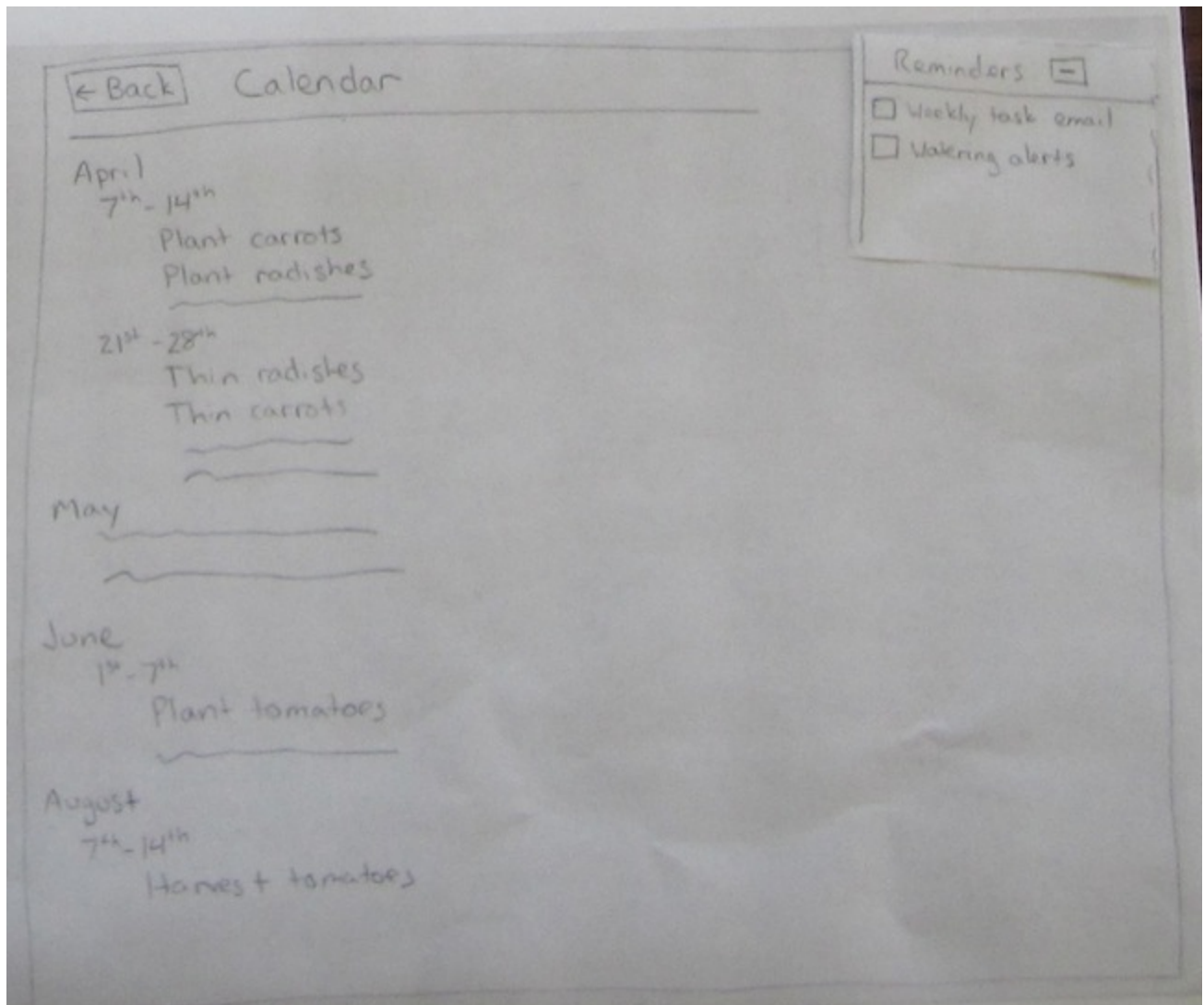
The find plants page consisted of a single page with a couple of search results panels to swap in when a user searched for plants. We prepared two results pages, for full sun and partial shade, and blocked out unrelated results when a user wrote in a specific plant.

Selecting one of the plant names from the list brought up the "Plant Details" page. The "Back" button brought the user back to the main garden page.



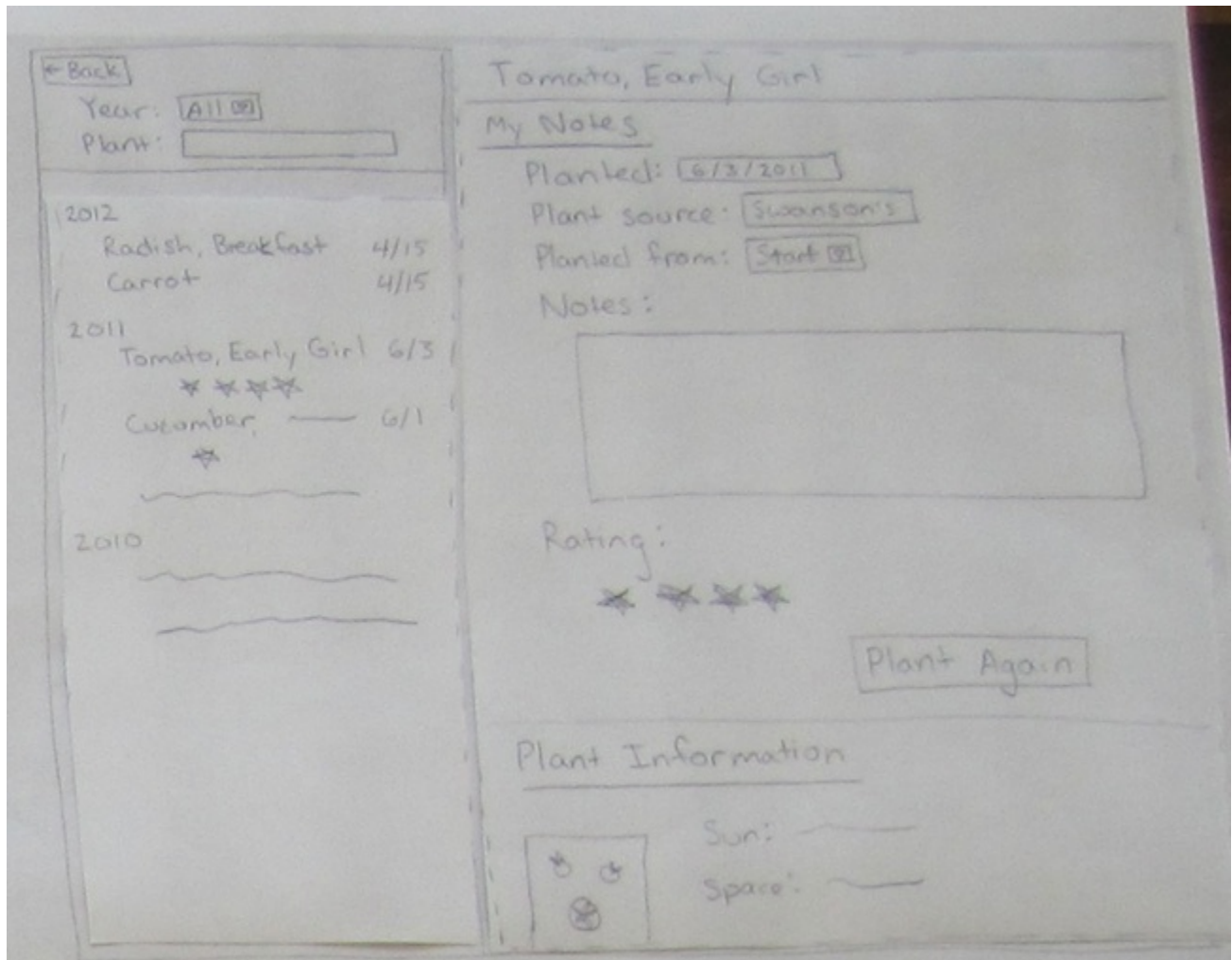
The plant details page had a right-hand panel with plant information which could be swapped in depending on the plant selected, and a left-hand panel that contained a form for planting information. The user was instructed to fill out the planting form with a pencil.

Selecting the "Add" button would bring the user back to the main garden page, with the plant being displayed on the details page selected and ready for planting. The month would also go to the planting date selected in the details page. The "Back" button brought the user back to the find plants page.



The calendar page consisted of a static set of example tasks, as well as a small “Reminders” button. Clicking the “Reminders” button opened up a small tab in the corner, which contained checkboxes for the user to write in.

Selecting the “Back” button took the user to the main garden page.



The notes page consisted of a pair of side panels, one containing a list of static plantings over the past year, and another that showed information about a specific planting. When the user selected an item from the plantings list, the corresponding information panel would be swapped in.

Selecting the “Back” button took the user to the main garden page.

Testing method

Participants

We had three participants, selected for their varying degrees of gardening experience. Elizabeth was working on her second year of Seattle gardening, and had a variety of beds throughout her garden. Chelsea was planting her first Seattle garden, and had a single small plot in the corner of a backyard. Karen was planting her third season at her current house, with a variety of beds, but had done a number of years of container gardening in her previous apartment.

Environment

Our testing environment was indoors, working at a table or flat surface. Since the intent of the application was to plan gardens on a tablet or computer before working in the garden, this seemed to be the appropriate choice.

Tasks

We had three tasks. We arranged the tasks in decreasing complexity, rather than increasing complexity, as this was a more natural way to familiarize the users with the application.

Task 1

The user was told that they had a 4-by-8-foot garden, running east to west. All of it was sunny, except a 2-by-2 square in the southeast corner. The user was told they wanted to plant a single row of carrots, and a single row of radishes, planting on May first, using plant starts. One of the participants pointed out that carrot and radish starts don't exist, so this was switched to seeds for the two final participants. The user was also told they wanted to plant a tomato plant, using the same plant variety planted in the previous year, planting at the same time. The user was then asked to create a representation of their garden in the app, and add the plants to it that they wished to plant.

Task 2

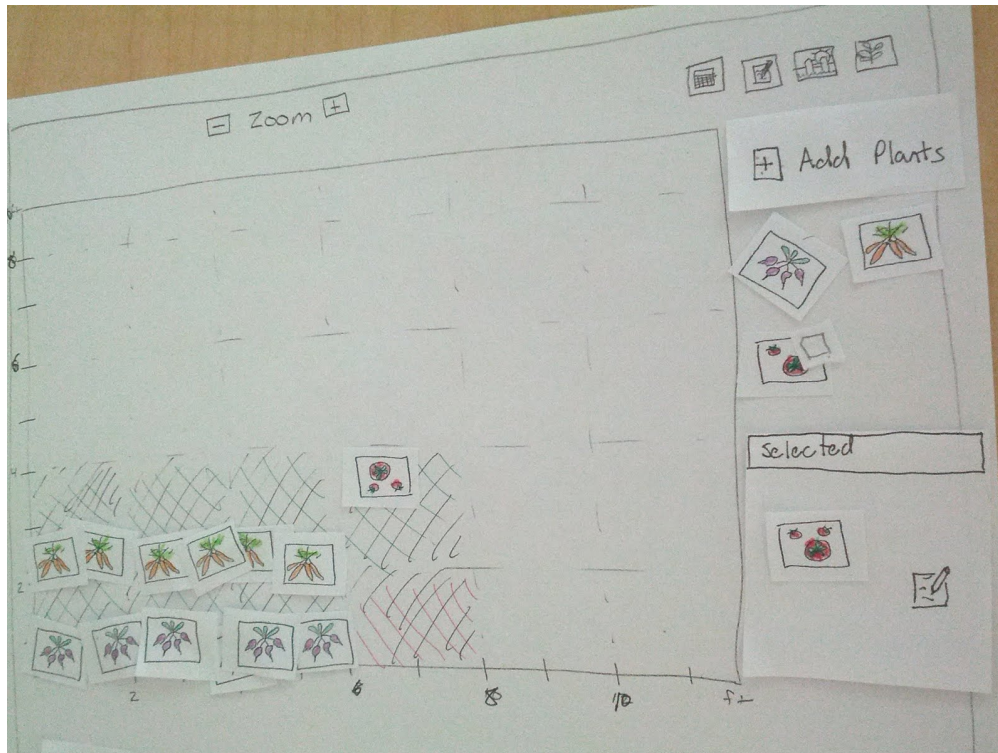
The user was told that they still had empty space in the eastmost two feet of their garden. They were told to fill the space with vegetables that would have a high food yield, and would do well in the light and climate. They were told to select and plant one plant for the sunny section and one plant for the partially sunny section using the app.

Task 3

For the final task, the user was told to configure the app to send out reminders to water the garden, and weekly task summaries. They were also told to find the radishes they planted this year in the app, rate them as a four-star planting, and add a note that they were particularly tasty in salads.

Procedure

We chose to conduct our interface testing solo, rather than in pairs, because our schedules were not amenable to interviewing together. As such, we both worked the computer and took notes during the sessions we worked.



Users were presented with the initial garden map, without any plants located on it. They were then read a narrative version of their first task, and asked to start working on it. Users were encouraged to explore the prototype when lost, rather than asking for advice, although sometimes hints were given if the user was very lost. Users were given small plant pieces to place on the garden for the plants, and were asked to draw in other garden features, such as the garden plot and the light level. See the image above for an example completed garden, from our third participant. She used different colors of cross-hatching for the differing light levels.

Test Measures

During testing, we focused on noting down the actions of our users, and especially noting areas where they were unable to figure out what action to perform next for their task. We also took care to note areas where we hadn't determined the proper interface element to display, or the exact interactions that would occur when the user selected an item.

Testing Results

Overall, we saw less confusion from the users than we'd hoped. They were generally able to perform their tasks without prompting, and didn't struggle to understand the purpose of the screens they were on.

The users were happy with the layout tools, and liked the ability to draw the local terrain for their garden. They found the interface fairly easy to use, and accomplished their tasks successfully. Two users really liked the ability to enter notes, although the other user said she probably wouldn't use it.

One consistent problem between users was confusion about what the icons on the initial garden

planting screen controlled. We'd used pictures with no text, and users were not always able to guess what they'd meant. Once they'd used the buttons once or twice, they remembered what it did, but they were definitely somewhat confused by the initial presentation.

Another point of confusion was the indicator label we used for location fitness when placing a plant. Some of this was because we weren't using fully-mocked fitness dialogs - we had very generic "OK", "warning", and "error" icons, without full text. However, even when the user had figured out what it was for, they were still a little unsure of when the light would change between colors.

In terms of usability, our details pages for the plants were missing a few key items, especially earliest plant dates. We also didn't describe if indoor starts were required, and didn't provide the user with a way to specify that a plant was started indoors, other than using the notes section (which one user did).

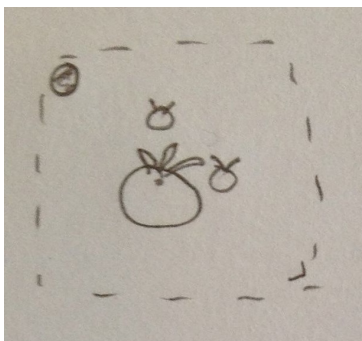
Another issue with the design that came up was the lack of a copy-and-paste feature for the plants. This was mentioned by a user when she was thinking about her garden, since it consisted of a lot of non-contiguous beds that would have required a large amount of hunting up of plants in our original model.

We were also asked to allow multi-year and permanent plantings. This feature was requested to save work in setting up the garden each spring and to support overwintering vegetables.

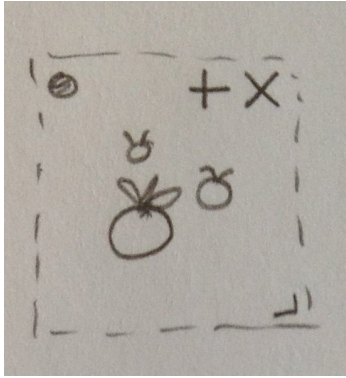
We also had a couple of specific requests from the users for added features. One was to add more reminders - fertilizer was mentioned twice, and slug warnings once. One participant requested both in-phone reminders (instead of email), and also wanted to have a print-out of tasks for reference.

Interface revision sketches

The biggest change we made in response to user testing was the addition of a "Copy" and "Delete" button on the planting page.

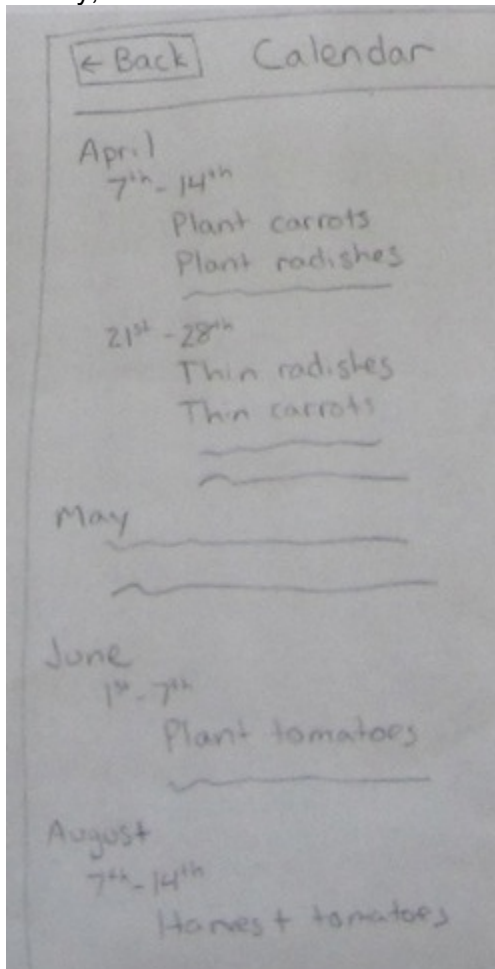


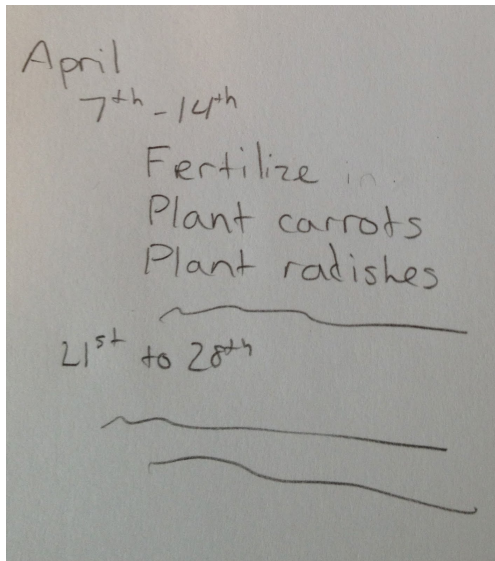
As seen above, the initial plant icons didn't allow the user to remove them, and didn't provide the user with a simple way to re-plant plants. We glossed over this in user testing, since we were working with cutouts, but it was important to add for the real interface.



We also removed the requirement of setting a harvest date for plants. This allows perennial plants to be treated as permanent parts of the garden and saves gardeners the work of re-entering plants each year. Long-term harvest dates may also be used for plants that overwinter, allowing plantings to cross calendar year boundaries.

Finally, we added fertilization tasks to the automatically generated task list in our app.





Interactive Prototype

Implementation Overview

We chose to implement a prototype of our application for the final stage of the project. We selected open source libraries that would help expedite development of base functionality such as layout, drag-and-drop, and date selection so that we could focus our development efforts on domain-specific functionality.

For our page layout and navigation, we selected jQuery Mobile. This open-source library creates attractive layouts and navigation buttons from simple HTML markup and also displays well on tablet devices. While we did not design our application for smaller interfaces such as smartphones, we wanted our web-based application to be easily accessible from both desktop and tablet browsers. We used jQueryUI to provide base drag-and-drop and resize functionality in our garden planning map's main view as well as to provide the date selection widget.

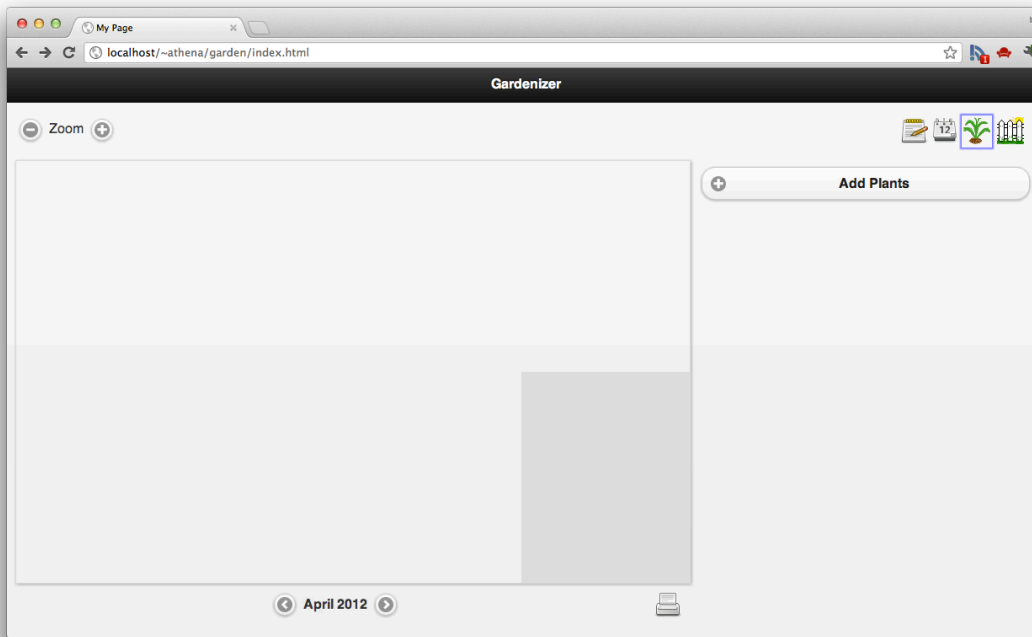
Our implementation is a single HTML page driven by JavaScript. Each "page" of the application is a separate HTML div element and navigation is controlled via the jQuery Mobile library. User customizations are saved to a local javascript variable and thus do not persist across manual browser reloads.

Sample application data was taken from the Territorial Seed Company and structured into a JSON data object. The prototype reads the JSON plant library into a local javascript object and dynamically renders plant lists and information screens based on a combination of user input and plant library attributes.

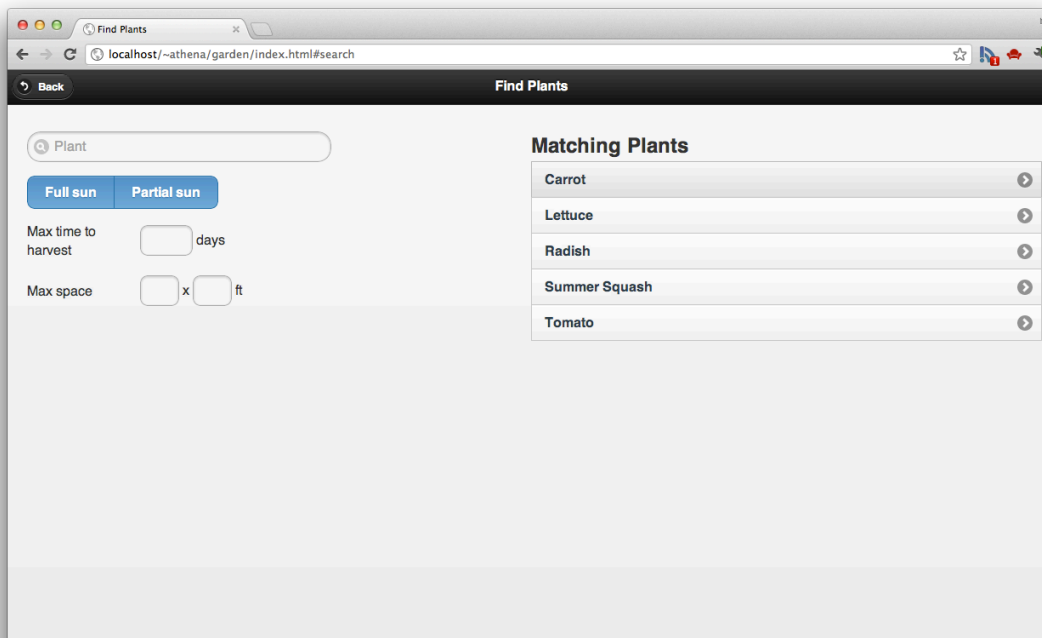
Scenarios for 3 tasks

TODO with screenshots matching expected path

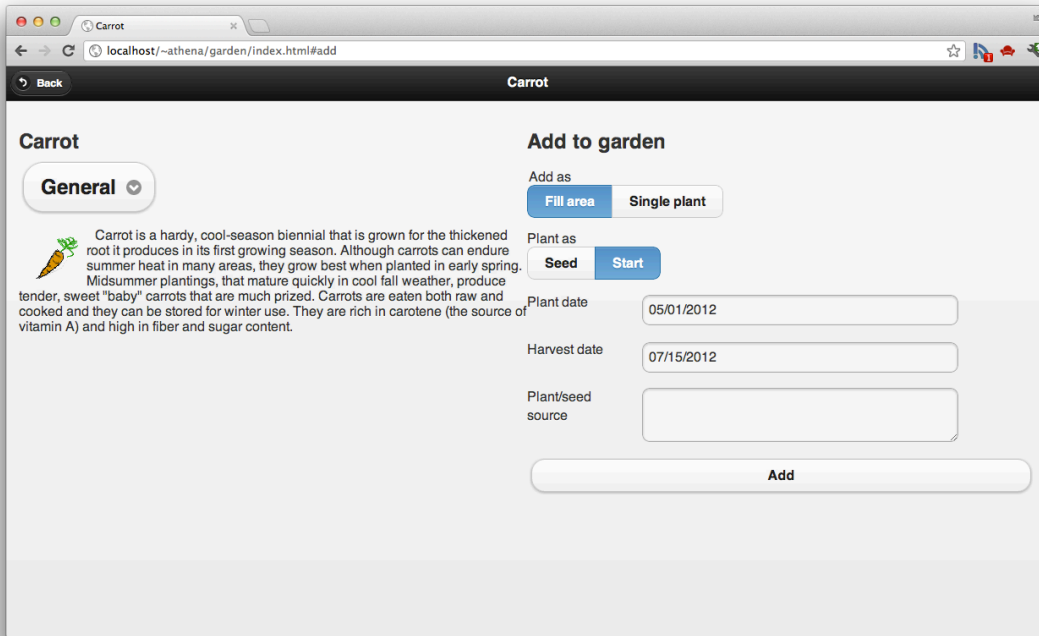
Scenario 1



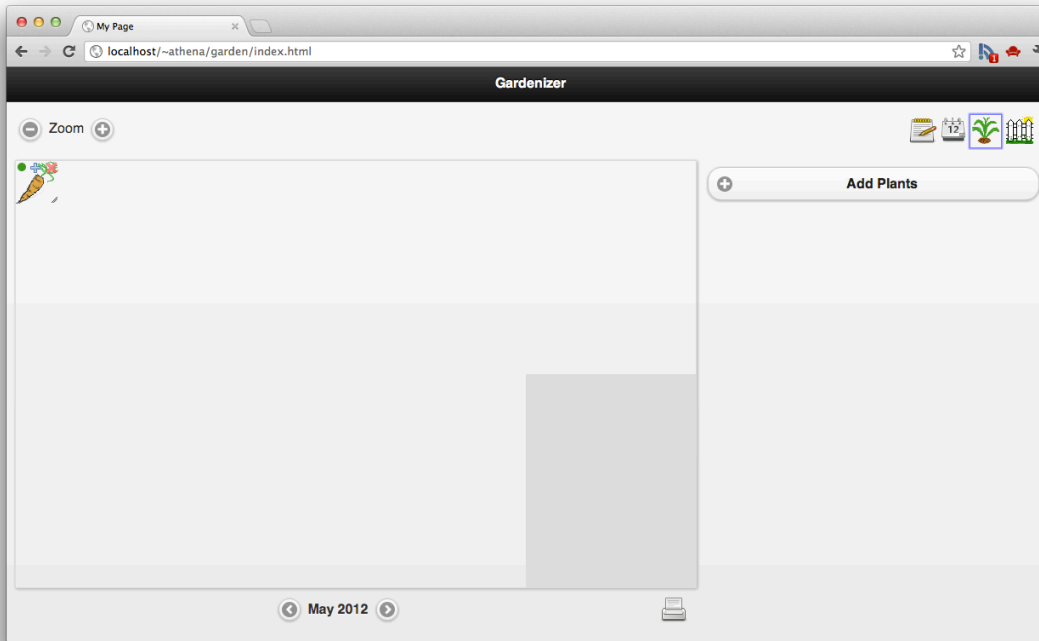
Click "Add Plants".



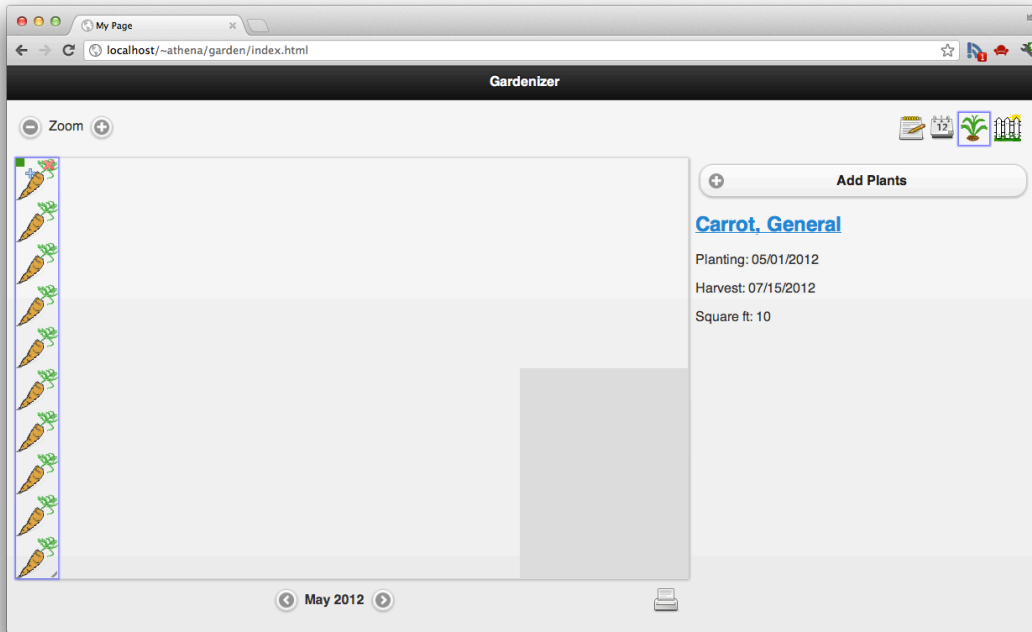
Click "Carrot".



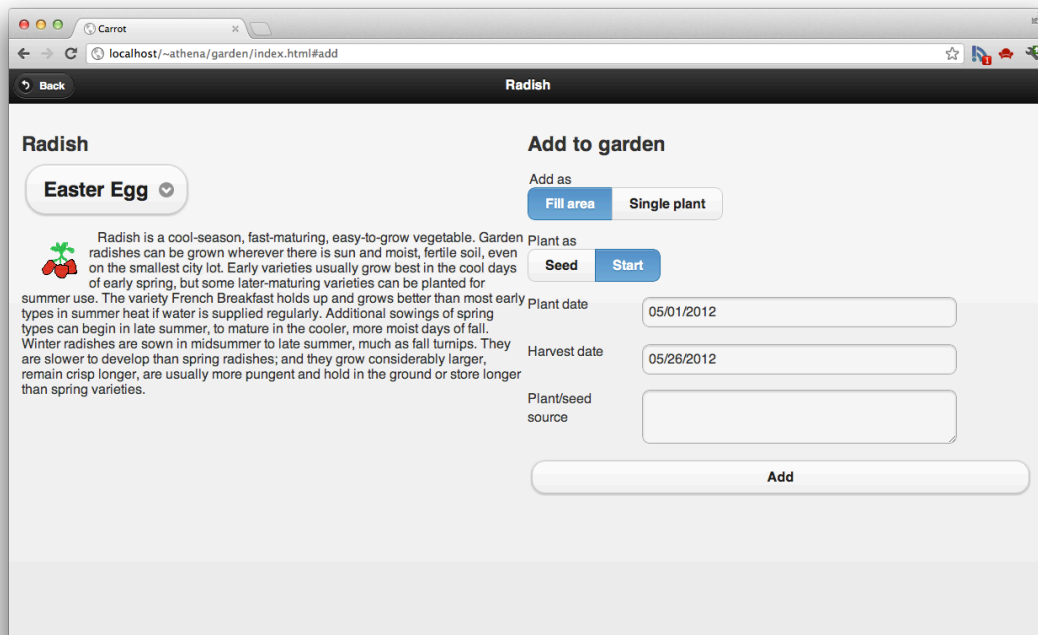
Click "Add".



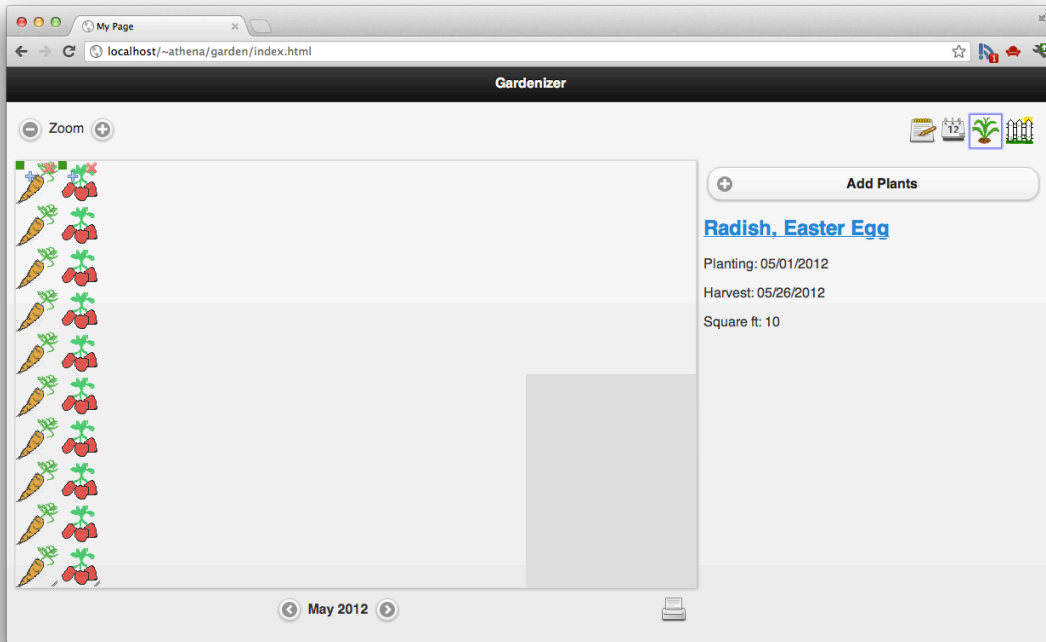
Drag the carrot to the desired location, and resize it to make a single row.



Click "Add Plants". Click "Radish". Drag the radish to the desired location, and resize it to make a single

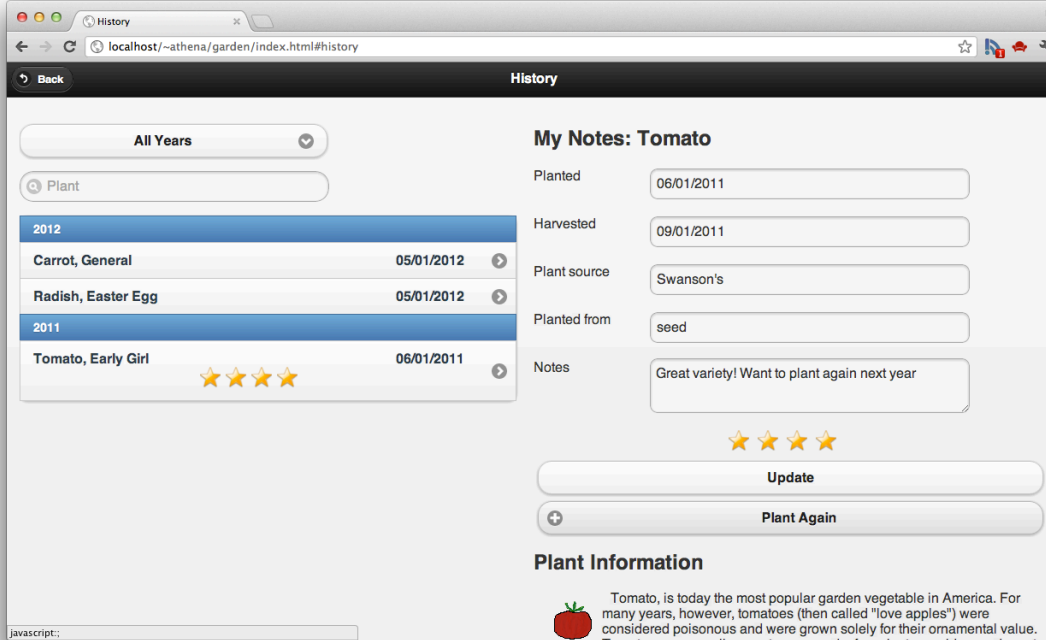


row.

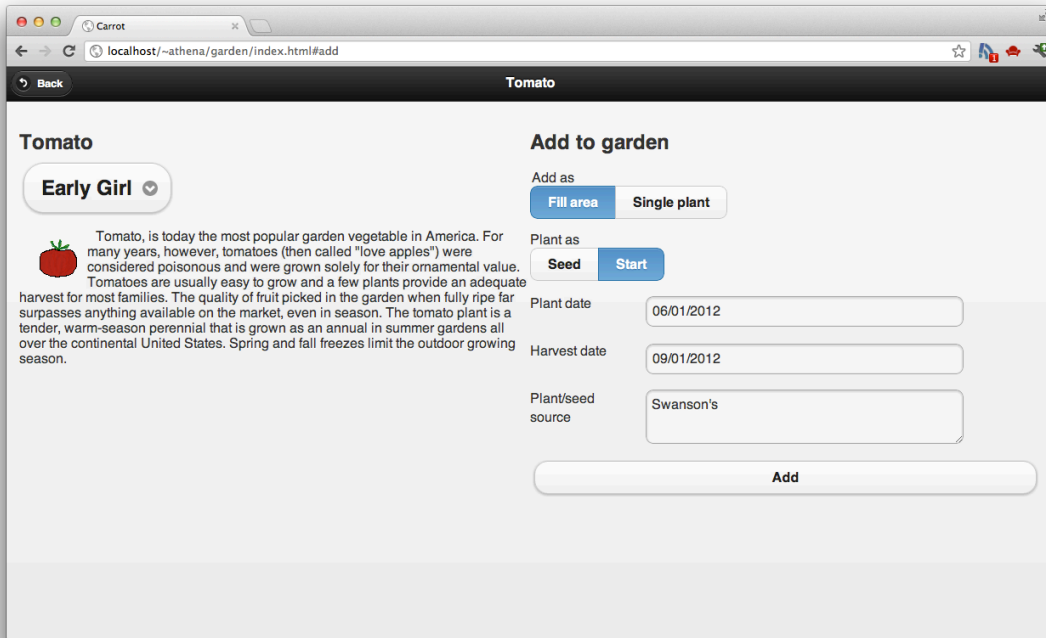


Click notes icon.

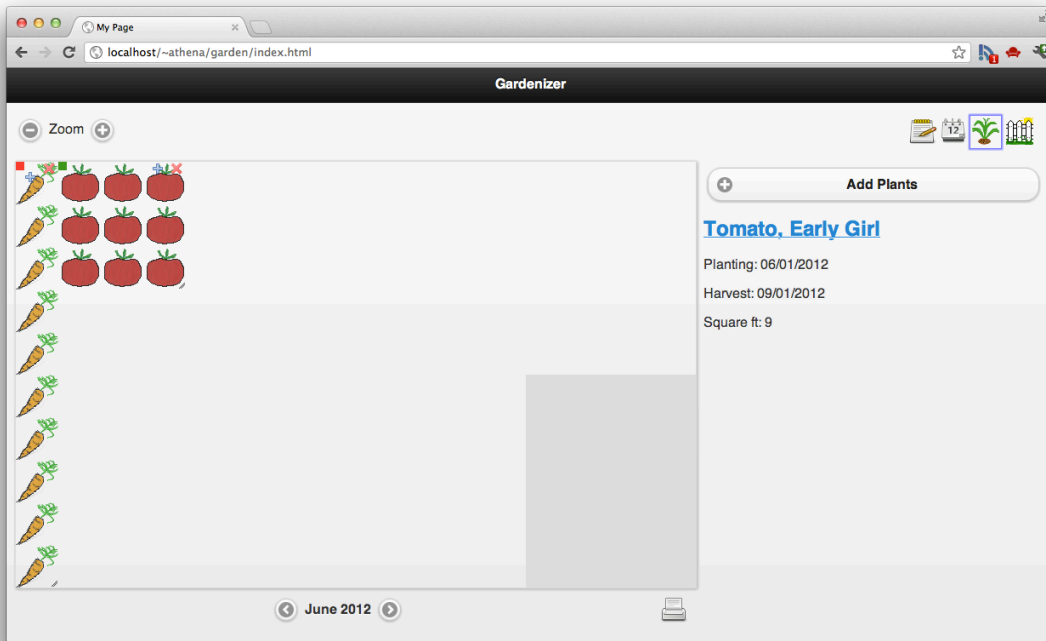
Click "Tomato, Early Girl" from the list.



Click "Plant Again".

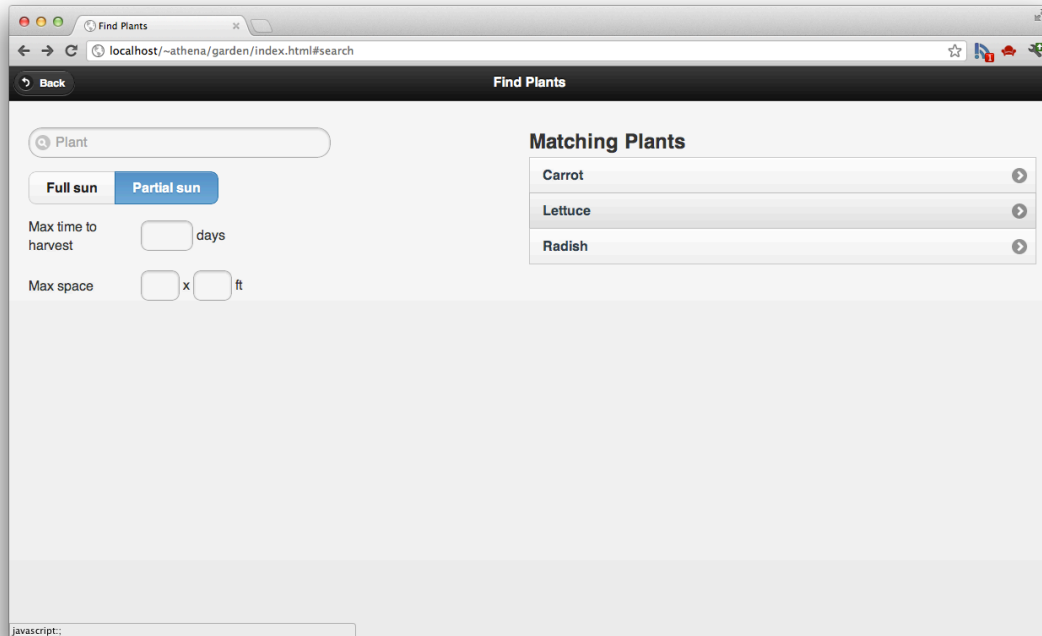


Click "Add". Drag the tomato to the desired location.

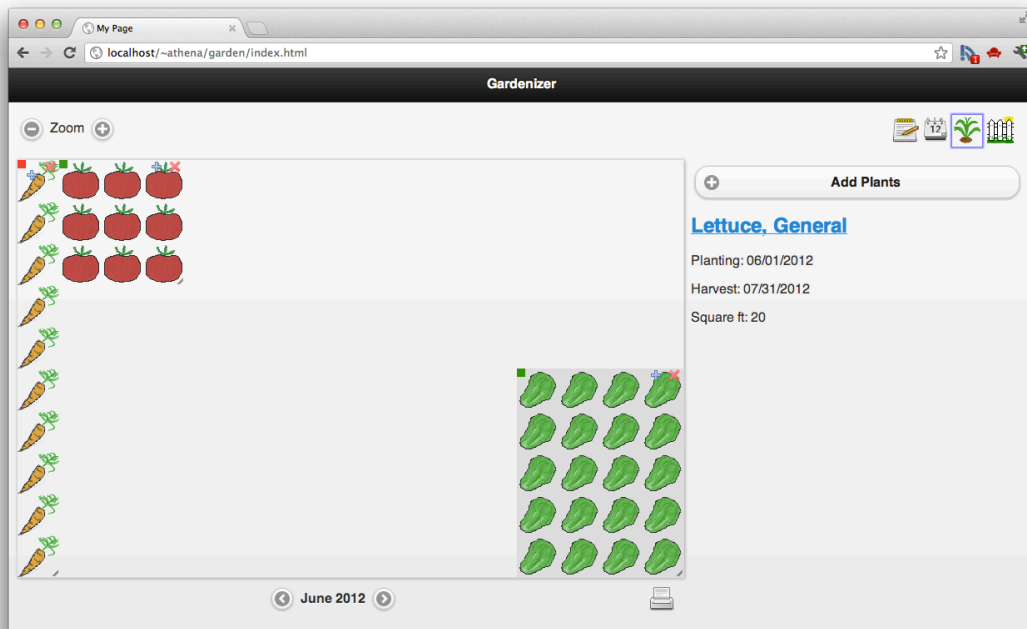


Scenario 2

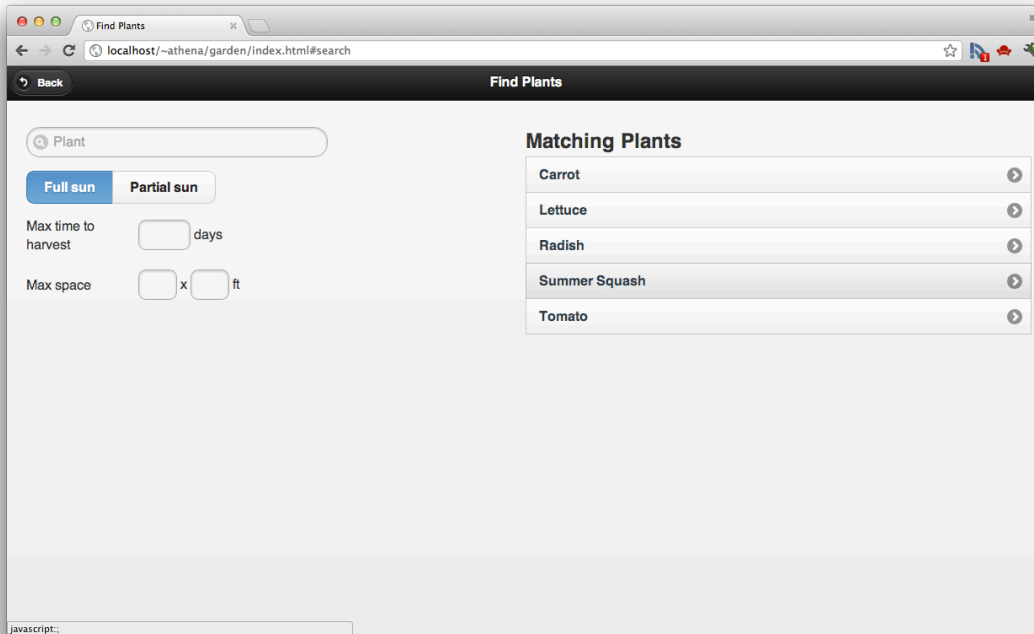
Click "Add Plants". Click "Partial



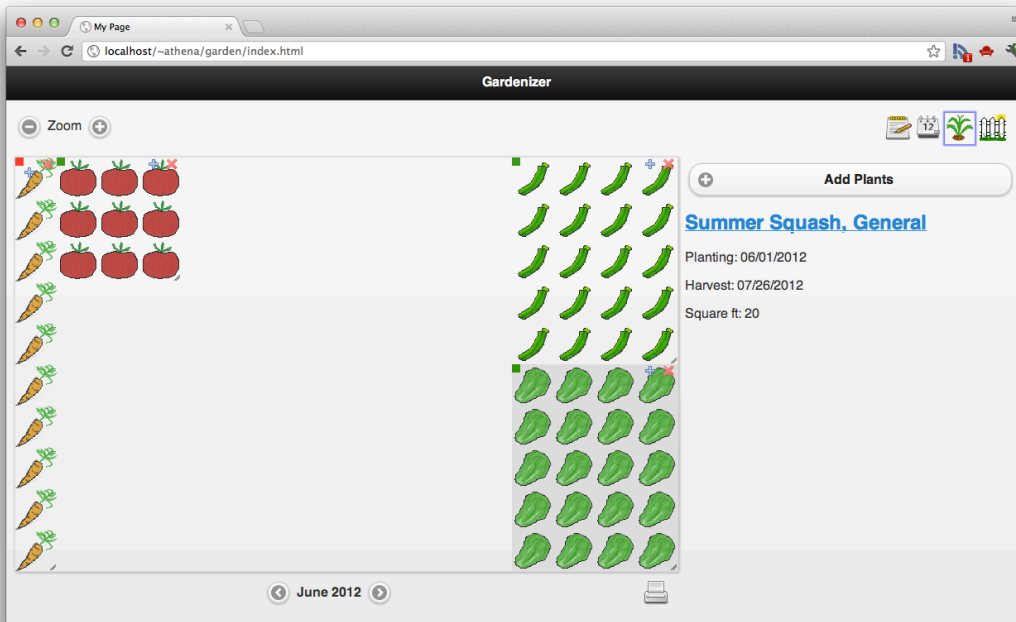
sun”.
 Click “Lettuce”. Click “Add”. Drag the lettuce to a desired



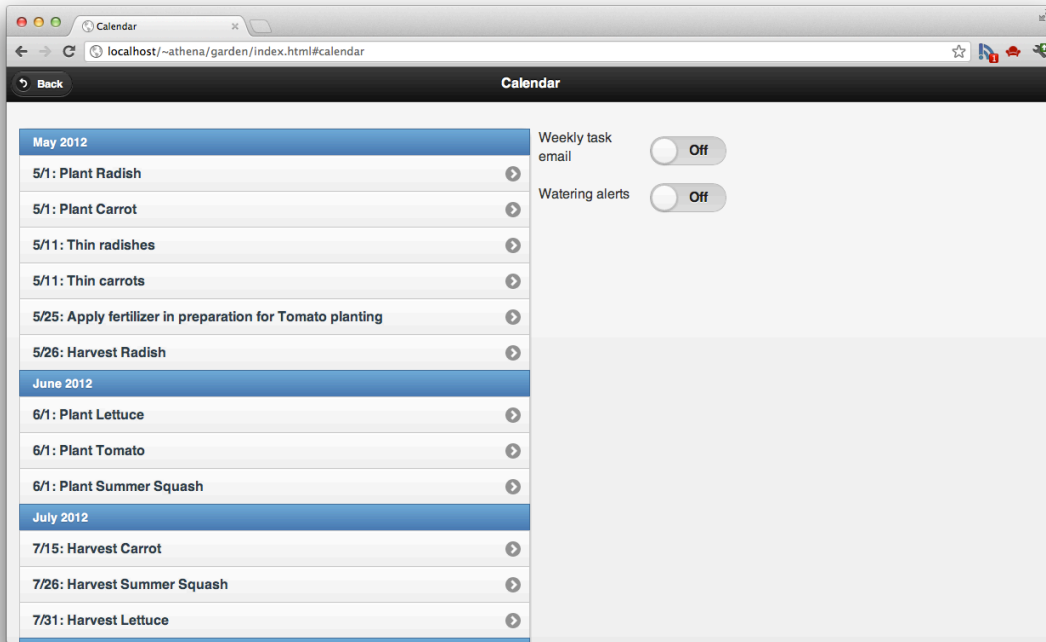
location.
 Click “Add Plants”. Click “Partial sun” and “Full sun”.



Click "Summer Squash". Click "Add". Drag the summer squash to the desired location.

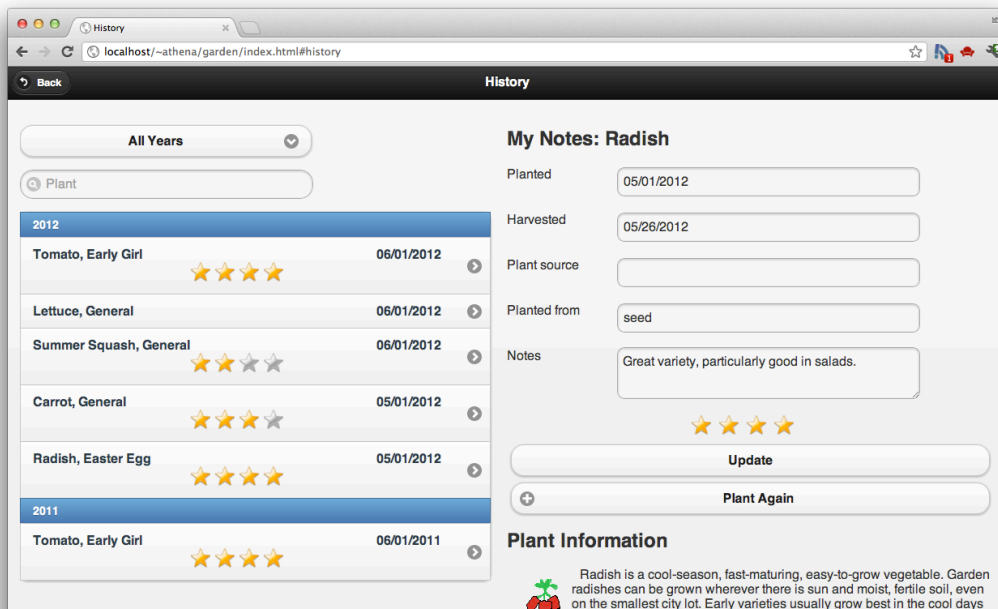


Scenario 3
Click calendar icon.



Click “Weekly task email” and “Watering alerts” sliders. Click “Back”.

Click notes icon. Click the first radishes on the list. Enter in the note “Great variety, particularly good in salads.” Click the fourth star.



Click “Update”.

Tools used to prototype

jQuery Mobile helped us quickly develop an attractive, usable interface. We used their functionality for page organization, navigation, and overall style. The library certainly helped us to bootstrap our project and was mostly reliable. We did find that the library didn't handle some of the two-column layouts as flexibly as we would have liked and had to write our own CSS to handle some of the layout.

jQuery UI was also quite useful in driving our map-based planning interface. The resizing and drag-and-drop functionality worked well and wasn't difficult to implement. We did encounter some skinning conflicts between the jQuery UI and jQuery Mobile libraries that caused some frustration and were ultimately resolved via custom CSS overrides.

What was left out and why

We chose not to implement the garden layout features, which we intend to allow users to create a physical map of their garden and its surroundings. We felt that this tradeoff allowed us to focus more closely on the activities most related to recurring garden planning activities.

We also eliminated zoom functionality from our prototype. While it's a feature that would certainly be useful in a production-quality version of the application, we felt that we could demonstrate the application's overall functionality without it. We did include zoom buttons in the interface to indicate that a more fully-featured version would offer zoom functionality, but attempting to interact with the buttons will display a "not implemented" message.

Summary and lessons learned

At the start of this project, we had a fairly good idea about what kind of a tool we wanted to build: A gardening application with an emphasis on plants co-occupying space in the garden. However, after going through user interviews, we realized that while users were interested in a gardening application with such a feature, they were as interested or more interested in having a strong gardening app by itself. In fact, in scoping out what our project needed, we realized that what we wanted most in the project - co-planting planning - was nearly subsumed by the other features we wanted to build to make the application fully-functional.

This discovery process - analyzing user needs - was perhaps the most useful exercise in designing our project. In our professional work, it's often the case that an application is built without talking to any users at all; and it's nearly universally the case that developers don't have direct contact with non-developer users. Speaking with real users, whether they confirm or contradict your preconceptions, is extremely useful, and really helps to guide the implementation.

Apart from the task analysis, the process of paper prototyping was very useful, and an extremely helpful technique for organizing thoughts and layout. Just the process of making the prototype was helpful, since it let us get a few semi-realistic ideas in our heads about what the application would look like. In many ways, getting users to play around with the prototypes was less exciting than the design of the prototypes, although it was an excellent way to figure out what features we had omitted from the design.

In some ways, the hardest overall part of the process was figuring out which features weren't needed in the final application. We had a pretty big list of features we'd brainstormed for the

application before the initial task analysis, and it was hard to get users to confirm or deny if they wanted specific ones. It would have been even better to have come to the table with no preconceptions; but that would have been very hard, since we'd specifically set out to build a gardening application because it interested us. In many ways, this problem goes away when working for a business, since the space is generally defined externally from the development team.

All in all, the process was excellent, and really opened our minds to planning projects in a user-focused way. Many of the techniques, especially low-fidelity prototyping, are already becoming useful in our day-to-day jobs. This was a great experience, and will definitely shape the approach for our future projects.

Appendices

Credits

Plant detail paragraphs were collected from the University of Illinois Extension's "Watch Your Garden Grow" website (<http://urbanext.illinois.edu/veggies/directory.cfm>).

This project includes JavaScript, CSS, and image resources from the following open source projects:

- jQuery Mobile, under the MIT license
- jQuery UI, under the MIT license
- FamFamFam Silk icon set, under the Creative Commons 2.5 Attribution license
- Tango Desktop Project, under a general public domain directive
- Crystal Clear, under the LGPL

Test Scripts

These instructions were read aloud to the participants, rather than handed out.

Task 1

You have a 4 ft x 8 ft garden, oriented so that the length runs east-west. Most of it is sunny, except for a 2 ft x 2 ft square in the southeast corner that receives partial shade.

You want to plant one row of carrots and one of radishes, spacing the rows as close together as you can. You'd like to plant these on May 1 from plant starts.

You also want to plant a tomato plant. You remember that the tomato you planted last summer did particularly well, and you want to plant whatever variety you planted last year, on the same date you planted it, from the same source.

Create a representation of your garden, and add the carrots, radishes, and tomato to it.

Task 2

The east-most 2 feet of your garden is still open for planting. You want to fill this space with vegetables that will yield a large amount of food over the summer. You're open to trying new plants and would like to maximize that space with something fun and interesting but compatible with Seattle's climate and your garden's space and light availability. Find one type of plant to fill up the sunny 2 x 2 area, and one to fill up the partially-sunny section.

Task 3

You work full-time and lead a busy social life, so you'd like some help keeping track of garden maintenance. You'd like some help tracking the garden's growth over the summer, as well as knowing when to perform garden chores. Set the app to send you periodic reminders to water the garden and send you weekly task summaries. ~~While you're at it, determine when the tomatoes you've planned to plant will start to flower.~~ (Omitted due to lack of mock).

You also want to track your garden's growth over the summer. You've noticed that your radishes did particularly well this year. Rate the planting as 4-starts and write a note that it was particularly tasty in salads.

Raw data

Notes from testing are below.

Elizabeth

would say represents garden
assuming up is north - add compass rose
went through and labeled
label numbers as feet
went ahead and drew in
want to use zoom, saw that
was able to mark after a prompt
looking for way to add plant
want to plant tomato first?
prompted to look for a way to add plant, went right to plant icon
confused by find plants screen
clicked on tomato plant
wanted to look for history
said perfect
plant again
fill area was intuitive
filled in from starts
excellent
tell you how many starts to buy to fill area
wants path to mark stuff in garden
be able to overlay last year's garden
drag menu or copy/paste
way to keep things from last year, or template for multiple years
great - i want the app
make name itself bring up dialog
even just reminders and tracking would be useful without graphic layout
compost and slug reminders

second year or gardening
one raised bed, and some converted flower beds
rasperries, strawberries, kale, radishes, lettuce
broccoli, beans

Chelsea

NOTES

Had done gardening a bit. As a child, first year planting Seattle garden.
Small garden in backyard.

TASK 1

Don't understand start screen.

Start with plant; went to edit landscape after discovering plant. Lack of labels is confusing.

Added bed fairly easily.

Sun worked fine, figured out icons fine.

Went back to add plants, clicked plus.

Search for "carrot".

"who plants carrots from starts"?

Selected buttons.

Hoping it would change to may; it did.

Confused by green dot. Confused by OK.

Selected 2X4 carrots.

Back to "add plants"

Radishes selected. Confused after "add" whether needed to click radish icon again.

Played around with selector to figure out dots.

Went to "Add Plants" to find tomato last year; went back after not finding history option.

Tried "edit looking one" next, history / notes.

"Doesn't say if i'm planting one or an area . . ."

Oops, planted it in may. The other one it switched to may. That was confusing

It should repeat plant date.

TASK 2

Went straight to add. "Don't know what I'm looking for."

Clicked filter, picked zucchini.

Info doesn't really tell me about fill area or single plant. Select single plant from what i know, start from seed. Changed to start.

Planted zucchini!

Already have carrots, guess i'll do lettuce. Might plant earlier, since soil can be worked.

Gonna start inside (added note about indoor starts in "plant / seed source").

Plant from starts I made in my garden. 20th April.

Add another lettuce, change date to 3 weeks later, second half of shady area.

TASK 3

I'm going to click the little calendary button!

Confused by auto-list (because didn't match what had done). Figured out reminders quickly.

Click radishes. Write in note - "particularly tasty in salads!"

Click four-stars:

FOLLOW-UP NOTES

I would have played more without set buttons. Added surrounding area with map.

I would definitely add lawn & house.

Adding plants was easy, but not a lot of help. If I didn't have good guesses, might have been a failure. All the note-keeping seems a little . . . tasks are really nice. Notes seems like it's really time-intensive to write it in. I don't think I'd take a lot of ratings and notes. Easy enough to remember.

Karen

NOTES

A few years in Seattle. Three years in a house garden, container gardening before.
Used some planning apps, both on the phone and online.

TASK 1

Orientation of grid?

hard to find edit

want to click, edit by clicking squares

Tried add plants

row != squares

Used notes for exact kind

Add plants first.

Added w/o garden bed; let that happen.

Used unknown label.

After doing first row, realized sun was needed; added garden.

Did notes + selectors for carrots. Seed brand

Used single plants for both. Tested how close carrots were together.

Can't figure out how to find plants from last year.

Typed in "Taxi tomato".

Pulled up in results.

Tomato from start.

Used same date as other plants (fine).

Added notes. (source: fred meyer).

Planted in corner quadrant.

TASK 2

add plants.

2X2 feet; click zucchini.

Fill area; plant from seed.

Same date.

Fill area, start (lettuce)

5/19/12 plant ; add notes

TASK 3

(skip tomato blooming).

Click calendar.

Did notes by clicking plant + notes things.

FOLLOW-UP NOTES

Rows weird.

Prefer phone alerts to email.

Liked the ability to enter source and variety.

Visual calendar instead of list, print out calendar with tasks in blocks

Fertilizer.