



Sprout & About Usability Report

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Sprout&About is a mobile application that uses augmented reality (AR) and mobile technology to teach users about flora found in local nature park trails. Users walking within a Sprout&App-supported park can open their apps to scan 3D-printed “plant locators” that activate an augmented reality view of designated plants. The mobile app then relays information regarding that plant’s life cycle and ecological significance. Users can save plants they scan into a virtual collection, and share this information with friends through social media. Although currently only a prototype within the Department of Biomedical Communications (BMC) at the University of Toronto Mississauga (UTM), Sprout&About’s short-term goals are to become a campus-wide mobile application that teaches students, faculty, and UTM visitors about the flora of the surrounding area. Eventually, Sprout&About hopes to adapt its technology for more widespread use at other institutions that want to spread ecological awareness of their local flora.

The goal of this usability test is to evaluate (i) the app navigation and app design, (ii) the augmented reality functionality, and (iii) whether the app is easy and enjoyable to use.

PROBLEM STATEMENTS

- Can users successfully use and interact with the augmented reality viewer?
- Can users use the map to locate available Sprout&About Plant Locators (3D printed pots with a glyph)?
- Can users understand the main navigation without additional instructions?
 - Can users find more information about the plants they have scanned?
 - Can users interact with friends in the app?

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Primary Persona: Study Break Sion



“I wish I could learn more about the plants I pass by on my study breaks.”

Personality & Characteristics

- Nature lover
- Curious
- Enjoys going outside for study breaks
- Digital native (active mobile phone user)

User goals

- Identify plants important to the UTM area.
- Save the information about plants for future reference.

Sion is an undergraduate Sociology student at UTM. She spends most of her time at school studying in the library by herself. When she needs a break, she likes to take walks along UTM campus trails. As a lover of nature, she often stops to admire the different flora she passes by—taking pictures of them so that she can look up more information about the plant when she gets back to campus. However, she finds that sometimes the plants are difficult to identify on her own, and the information provided by signage is not enough to satisfy her curiosity.

She wishes there was an easier way to identify, learn about, and save dynamic, up-to-date information about plants she comes across while casually walking around UTM.

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Secondary Persona: Action Adventurer Aaron



“Gotta scan them all!”

Personality & Characteristics

- Interested in “flashy” mobile technology
- Social
- Will actively search for opportunities to use the app
- Active social media user

User goals

- Explore the UTM campus
- See AR models on his phone
- Connect with friends online and in real life

Aaron is an undergraduate Biology student at UTM who is always interested in trying out the trendiest new technologies like AR. He already uses mobile applications like Pokémon Go, but would love to use an AR app specific to UTM campus that he can use with his friends.

He hopes to use Sprout&About to see environmentally relevant AR models, save them to his phone, and share with his friends on his Instagram account. He would also like to be able to use the app to contact his friends to go exploring with him.

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User recruitment and testing breakdown

Six participants will be recruited for the usability test and split into two rounds of testing with three users each (see Figure 1). After initial testing with three users and based off their feedback, the prototype will be rapidly iterated for further testing with another three users. Participants are considered eligible if they were a UTM student or staff member and own a personal mobile device. All usability testing sessions will be held at the University of Toronto Mississauga at the Terrence Donnelly Health Sciences Complex on the third floor.

Testing protocol

Four people will be involved with each usability test: the participant, the moderator and two data loggers. The role of the moderator will involve reading the orientation script, reading the scripted tasks, beginning and stopping tasks, and answering questions from the participant. Data logger #1 will be responsible for transcribing what the participant says and recording qualitative information on the state of the participant (e.g. frustrated, annoyed, calm, amused, etc.). Data logger #2 will be responsible for recording the path to completion the user takes for each scripted task and timing each scripted task.

Participants will remain in the starting room until moderator has finished reading through the orientation script and has received oral consent to proceed with the test. Participants will be asked to speak aloud their thought process, as well as have the freedom to explore the 3rd floor of the building however they wish to complete tasks. The moderator will read aloud the first scripted task and then hand the participant the phone to complete the task. The task will end if (a) the participant verbally confirms with the moderator that they think they have completed the task or (b) the moderator ends the task due to the participant spending the maximum allotted time for that specific time. The moderator will then instruct the participant to stop interacting with the phone and wait to listen to the next scripted task. This sequence repeats for all the tasks outlined in the Task List section. After all the scripted tasks have been completed, the participant will then be asked to provide general feedback on their experience using Sprout&About as well as any questions, comments, and suggestions they may have.

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Prior to the usability testing session, the Android mobile phone (see Test Environment and Equipment Requirements for phone specifications) used will have Sprout&About V2.0 installed for the first round of testing and Sprout&About V2.1 for the second round of testing. Notifications (Whatsapp, Facebook messenger, etc.) will be turned off to remove visual elements unrelated to Sprout&About from appearing on the phone screen during testing; it will also be set on silent mode. The testing environment will be arranged and equipped as described in the Test Environment and Equipment Requirements section (see Figure 1).

Data analysis

The individual's time for completion of each task will be reported but not used outside of helping the moderator determine a failure state during testing. Other quantitative results—such as the number of completed vs. uncompleted tasks—will be recorded for thematic analysis. Qualitative data (pathway to completion, user states) will also be collected and thematically analyzed.

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Usability testing will take place in the department of Biomedical Communications in the Terrence Donnelly Health Sciences Complex. The user will begin in HSC 328 for the first round of testing and in HSC 316 for the second round of testing. They will be required to remain in their respective rooms until the usability test begins. The moderator will remain to the left of the user and follow them as they move towards the Plant Locators. Data loggers will always remain behind the user as they complete each task. The plant pot locator will be positioned at the end of the hallway, in front of the entrance to the bridge to the Davis building. It will be placed on top of a chair.

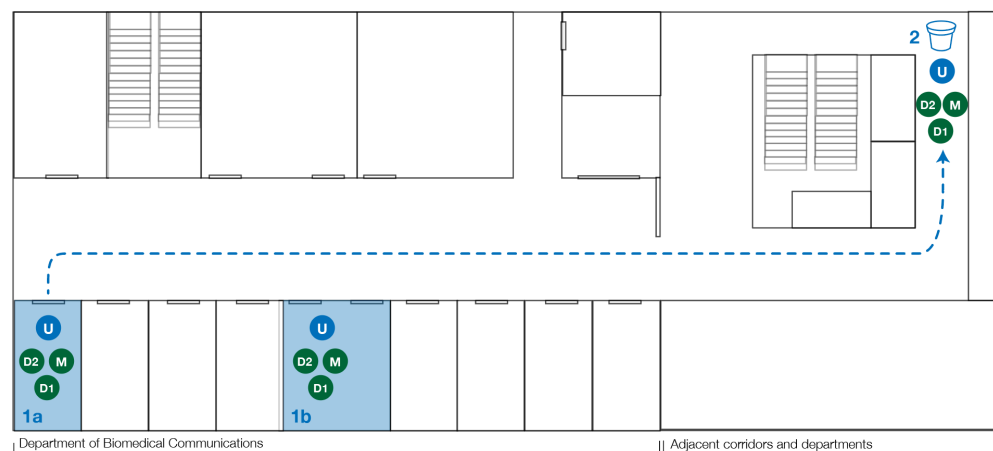


Figure 1: Testing setup. Users (U) begin in HSC328 (1a) for the first round of testing. Users begin in HSC316 (1b) for the second round of testing. Moderator (M) and data logger 2 (D2) stand near to the user during testing, while data logger 1 (D1) will stand slightly further back. User will start in an initial room (1a or 1b) and move towards location 2 (entrance to bridge of Davis building) as they complete the task list.

Equipment Requirements

- Mobile phone with Sprout&About V2.0 (testing round one) or V2.1 (testing round two) installed.
- Phone specifications: Android LG G5 Pro (4 Gb RAM, 16MP camera, display resolution of 1440 x 2560 pixels)
- Four chairs: one for each of the people involved in the usability test and one for the plant locator
- Two 10" iPadPros and Generation 1 Apple Pens for data loggers to record
- One 3D printed Sprout&About plant locators with a glyph corresponding to the White Trillium
- Stopwatch timer

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- 1. Moderator:** They will be responsible for leading the testing session; they will guide the user through the session by reading from a provided script throughout the test (Appendix A). The moderator may also stop the participant from performing tasks if they deem it necessary. The moderator should have a calm and friendly demeanour, and not provide more information prior to testing than what's indicated in the protocol. The moderator may answer questions once testing has been completed; during each scripted task, the moderator cannot provide any further instructions besides repeating the task.
- 2. Data logger #1:** They will be responsible for transcribing what the participant say as he/she is completing the task (i.e. their thought process) and recording other qualitative measurements as mentioned in the methodology.
- 3. Data logger #2:** They will be responsible for recording the pathway the user takes to completion for each task (number of taps/clicks that the user makes will be inferred from this data post usability testing). They will also be responsible for starting and stopping the timer and recording time measurements for each task throughout the testing process.

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For each task in this usability test, there will be two main criteria for success:

- 1) Reaching a certain endpoint within the application (e.g. getting to a specific page, clicking the required button, etc.):
 - Success: User has completed all objectives within a task.
 - Partial success: Completing a minimum of one subobjective or taking an unideal path to completion (*ideal paths outlined within results).
 - Failure: User has failed all objectives within a task.
- 2) Time for task completion, measured from the time the user begins the task to the time when the task ends (see the Methodology section for the definition of task ending):
 - a) Success: User has completed task within specific time limitation.
 - b) Failure: User has exceeded allotted time, and task is considered a failure regardless of whether above objectives have been met.

Depending on the task in question, the specifics of each criterion vary. Please see “Task List” section for a detailed list of criteria for each task.

Constraints

- For certain tasks, users will operate within a time limit.
- For certain tasks, users will be required to achieve the goal in a set number of clicks.
- Users will not be allowed to search the internet for any answers.
- Users will not be allowed to search the computer for any help documentation.
- Users will not be allowed to ask the moderator, data logger, or any member of the testing crew for assistance in understanding the application. Crew members may clarify questions regarding instructions and tasks, providing they do not reveal how to perform an action to the user.

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Can users understand the main navigation without additional instructions?

Task 1: Completing the tutorial screens.

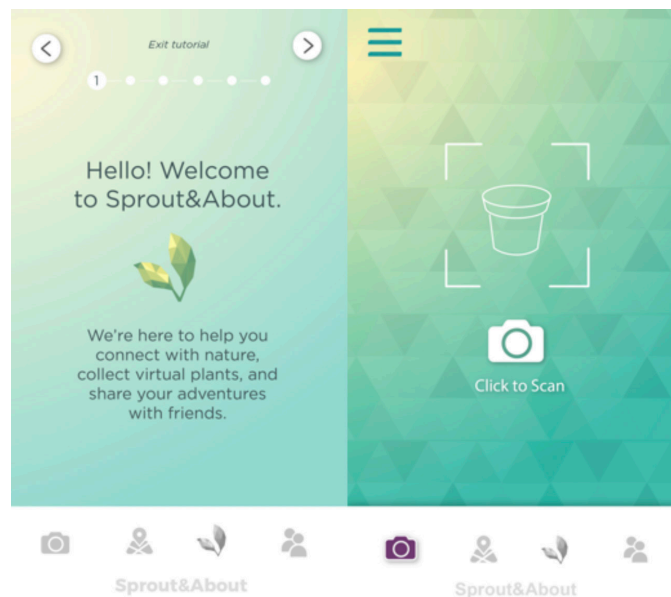
Start state

- App: First screen of tutorial
- User: Standing at the room entrance

Conditions for success

- User successfully completes the tutorial and lands on the home screen.
- User completes the tutorial in under two minutes.

Starting and ending screens



Script: You have just downloaded and logged into Sprout&About via social media. Begin by completing the tutorial, and verbally confirm when you are finished. Please let us know if you have any questions after completing the tutorial.

Post-task completion: Now that you have finished the tutorial, what do you think the goal of this app is and how can you achieve this?

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Can users use the map to locate available Sprout&About Plant Locators (3D printed pots)? Can users successfully use and interact with the augmented reality viewer and 3D AR?

Task 2: Locating plant pots with the map function and triggering the 3D AR models to appear

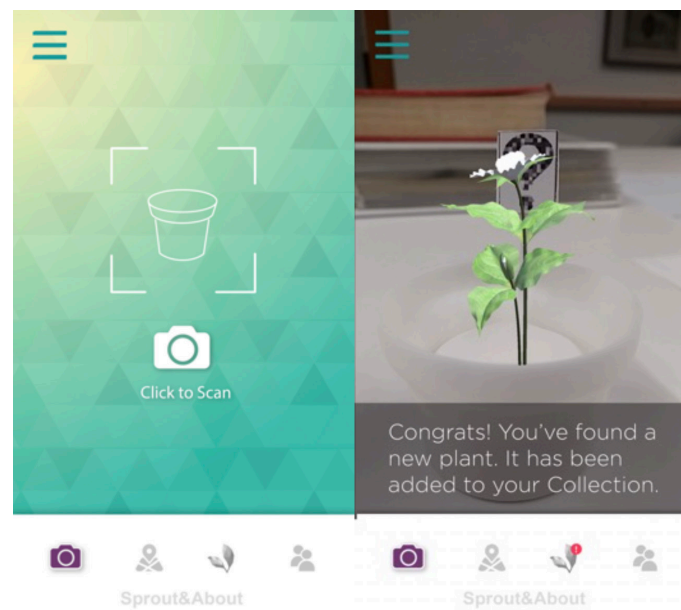
Start state

- App: Home screen (Scan Mode)
- User: Standing at room entrance

Conditions for success

- User successfully navigates to Map Mode, and is able to identify where plant locators are in relation to themselves.
- Using map mode, user is able to physically navigate to a plant locator.
- User is able to position device into the correct orientation and trigger the AR 3D model to appear.
- User completes task within five minutes.

Starting and ending screens



Script: Using the app, locate a plant that is near you right now and add it to your collection.

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Can users find further information about plants they've scanned?

Task 3: Finding plant information.

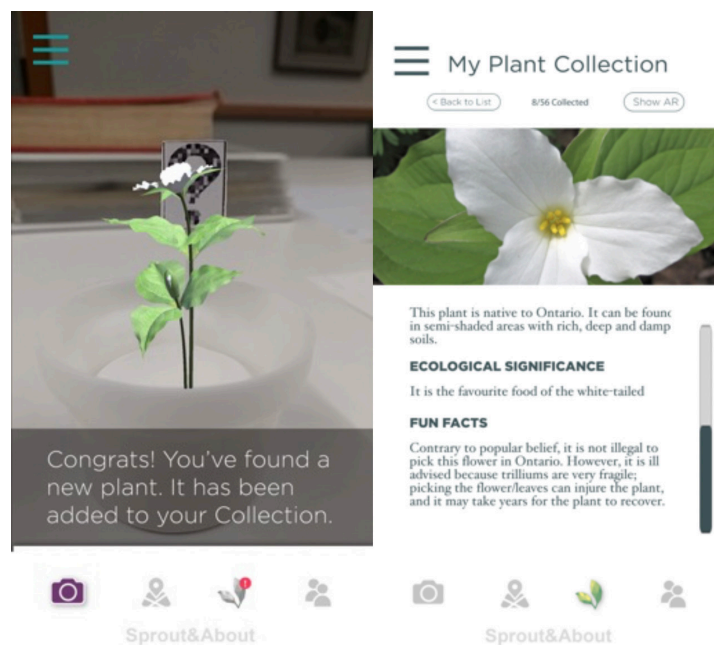
Start state

- App: Camera mode (from previous task)
- User: Standing in front of one of the plant pot locators

Conditions for success

- User is able to navigate to the plant list information page and find additional information on white trilliums
- User is able to complete the task within two minutes.

Starting and ending screens



Script: You have successfully scanned a plant model and you want to find out more information about its ecological significance. Please tell us the ecological significance of the plant you have just scanned.

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Can users interact with friends in the app?

Task 4: Using the app to interact with friends

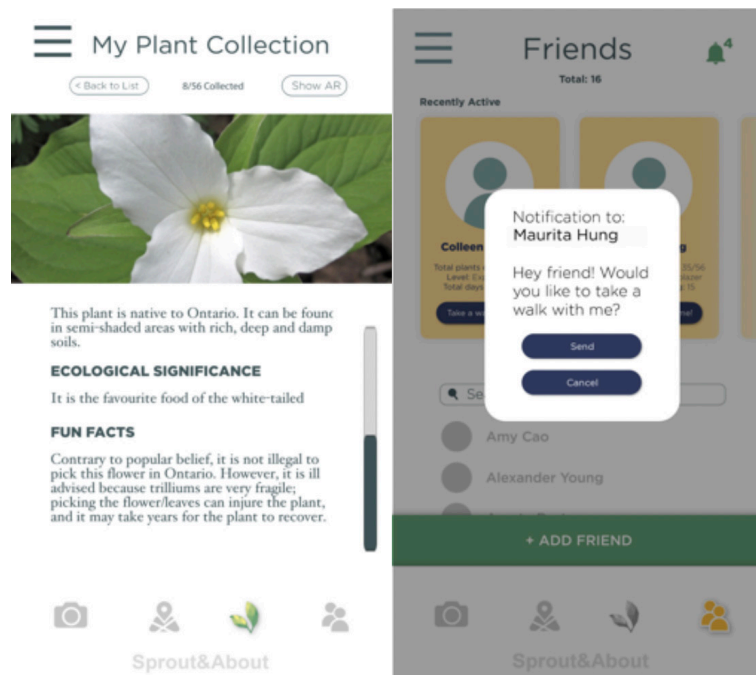
Start state

- App: Plant information page for white trilliums (from previous task)
- User: Standing in front of one of the plant pot locators

Conditions for success

- User navigates to Friend Mode and successfully sends a notification to Maurita Hung.
- User completes task within two minutes.

Starting and ending screens



Script: You would like to take a break from working for 10 hours straight at BMC. Use the app to ask Maurita Hung to explore the UTM trails and learn about the surrounding flora with you.

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Task 5: Share a plant on their social media.

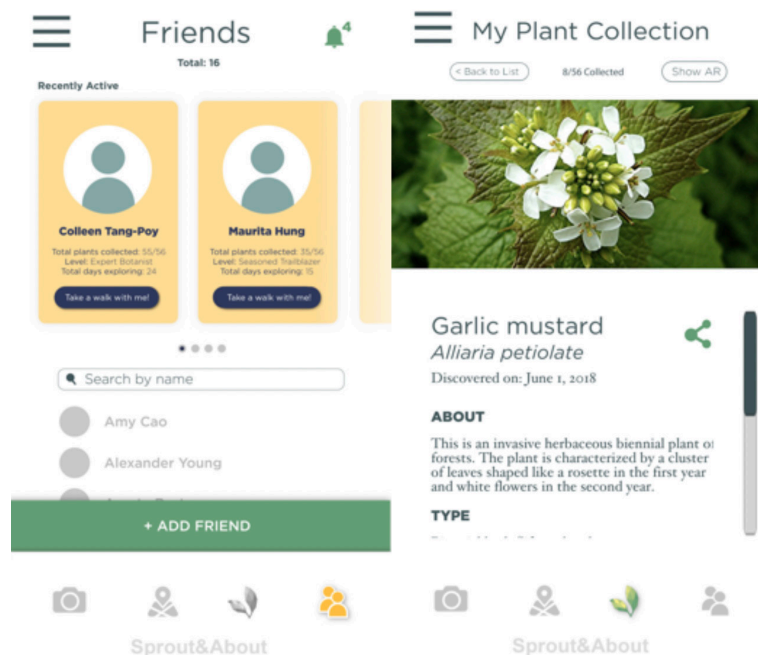
Start state

- App: Friends screen (from previous task).
- User: Standing in front of plant pot locator.

Conditions for success

- User attempts to clicks the social sharing button (the button is currently not functional so the user does not actually have to share it to social media).
- User completes task within one minute.

Starting and ending screens



Script: Now that you have collected some plants, you want to share them with your friends. Please attempt to share the garlic mustard onto your social media page.

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Test task	User performance: Success (S), Partial Success (PS), Failure (F)			Key observations and feedback
	User 1	User 2	User 3	
1. Tutorial completion	S	S	PS	-User labelled “partial success” did not exit the tutorial before indicating completion. -Users consistently tried to interact with menu buttons during tutorial; however, after swiping one or two screens they realized that menu buttons were not interactive.
2. Locating plant with map and triggering AR.	PS	F	PS	-Two out of three users eventually realized that they needed to use the map (“partial successes”). - Users were universally confused about what the map was for. Some users did not know that they needed the map to locate plants, and tried to scan real plants in the room. - On map, users were consistently confused by which icon represented themselves and which icon represented the plant locator.
3. Finding plant info	S	PS*	S	-User marked “partial success” did not click the highlighted plant, but read the “most recent” tab and clicked the plant located at the top of the list.*
4. Interacting with friends	S	S	S	-Tests completed easily.
5. Social sharing	S	S	S	-Tests completed easily. Users indicated universal familiarity with the connection/sharing icon.

Additional key comments:

- Enjoyed the graphical style of the design and found the layout clear and intuitive.

* Prototype error: the most recent plant at the top of the list should have corresponded to the highlighted plant

Based on testing with users 1-3, the prototype was revised in the following ways for further testing in sessions 4-6:

- 1) Tutorial screen changes:
 - a) Text describing the menu was altered to decrease suggestion that users should actively click menu buttons during tutorial.
 - b) Photo of the 3D-printed plant pot locator with a glyph was added to tutorial, to help users recognize that they needed to find this locator for the scanning test task.
 - c) Forward and back buttons were removed, “swipe to continue” was added.
- 2) Map screen icon changes: A “person” icon is now used to indicate the location of user instead of a red pin, and the sprout logo is now used to indicate the location of the nearest plant instead of a question mark.

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3) Plant screen prototype errors: Fixing prototype errors: white trillium was moved to the top of the plant list (in order to indicate that it was the most recently scanned plant). The height of the text box on the ecological significance of white trillium was adjusted such that the text was fully legible.

Test task	User performance: Success (S), Partial Success (PS), Failure (F)			Key observations and feedback
	User 4	User 5	User 6	
1. Tutorial completion	PS	S	S	-User labelled “partial success” did not exit the tutorial before indicating completion. - Users consistently tried to interact with menu buttons during tutorial; however, after swiping one or two screens they realized that menu buttons were not interactive.
2. Locating plant with map and triggering AR.	F	F	PS	-Only user three (“partial success”) eventually figured out how to use the map to find the plant pot locator. - All other users attempted to scan real plants around the room, and did not attempt to use the map before indicating that they were finished the task. - Users consistently asked for where they could go to repeat the tutorial, or if there was somewhere they could go if they had more questions.
3. Finding plant info	S	S	S	-Tests completed easily.
4. Interacting with friends	S	S	S	-Tests completed easily. One user indicated that they wanted to use to app to choose a specific nature trail to take a walk on before requesting a friend take a walk with them.
5. Social sharing	S	S	S	-One user indicated that their initial reaction was to use the “friends” feature to share plants, because friends were correlated with social network.

Additional key comments:

- A user indicated that, although they knew they needed a code to scan, because they could not see one in the room they did not think they could look for it. The user indicated in de-brief that they did not think they would not use the map function in the real world.
- A user indicated that, due to their prior exposure to Pokemon GO, they expected the map interface to resemble the map in that game and were thus confused by the app’s map function. They expected live feedback (in the form of an arrow, icon, etc) from the map while using it similar to the Pokemon GO interface.

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Successful test tasks

All users were able to find plant information, interact with friends, and share plants to their social media easily. Despite some users indicating preference for different paths to completion (for example, one user wanted to select a specific nature trail before selecting a friend to take a walk with), all users completed tasks without confusion. Based on these results, we can assume the MyPlant Collection, Friends, and Social Sharing features are intuitive and easy to use. Furthermore, the main navigation is straightforward, given these test tasks spanned different pages within the main navigation and users were able to switch between screens easily.

Partially successful test tasks

Completing the tutorial: The two users marked “partial success” did not exit the tutorial before confirming that they had completed the task, meaning that we could not test the “exit tutorial” button with them (Tables 1 and 2). This may indicate that the “exit tutorial” button is not salient enough and that some users did not know it was there. However, this could also be attributed to a limitation in the testing setup, as users were only asked to “complete the tutorial” and not “complete the tutorial and exit when finished.” This is supported by the observation that those users did successfully recognize the final tutorial screen, and may have assumed the task was simply to reach the end of the tutorial. All users experienced some confusion when completing the tutorial because they thought the main menu buttons were clickable. Since the screens were static and the text/arrows were only there to explain features, users had to swipe through one or two tutorial screens before realizing that the buttons were static. Although this did not interfere with tutorial completion, this could potentially contribute to poor user experience by making users feel confused. Overall, we can conclude from these findings that the tutorial was mostly straightforward, and the “swipe to continue” and numbered tutorial screen features successfully guided users to completion. However, the tutorial screen design may need to be revisited in order to reduce confusion and improve user experience.

Triggering augmented reality in task two: The users that eventually used the map to locate a plant pot had difficulty triggering the augmented reality function (Tables 1 and 2). This is in part due to a limitation with

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the prototype, as the plant pot glyph was printed fairly small and the user needed to bring their camera very close to successfully trigger AR. Some users also did not recognize the “?” glyph as the code they needed to scan, and attempted to scan the whole pot in different conformations.

Failed tasks:

Users had universal difficulty with using the map function to locate a plant for scanning. This may be due to several factors, as well as limitations with testing itself:

- Lack of signage and explanation within the app that clarifies what users should be scanning. Although the “scanning” screen had text that specified searching for a “flower pot pattern”, users did not seem to read this when attempting to scan (attention was entirely focused on camera view). Although we modified the tutorial to include a photograph of the 3D-printed plant pot locator in round two of testing, users did not seem to remember this when using the camera mode.
- Lack of ecological validity. Users in the real world would most likely use this app for the first time after coming across a park sign with a locator already on it (or, after watching/hearing about a friend using it). Because we asked users to download Sprout&About away from actual park trails and signage, this may have confused users about the capabilities of the app.
- Limitation in testing set-up itself. The usability testing took place in semiformal conditions with users beginning in a testing room. Some users may not have realized they had the freedom to leave the presumed testing space. This is supported by the observation that although some users opened the map, they did not use it because it was not a map of the room. Furthermore, because we wanted to avoid leading users and influencing behaviour, we avoided giving hints about where they could go. This may have limited our description of the app when introducing it to users, and they may have wrongly assumed that Sprout&About was meant to scan any plant, rather than coded plant pots.

Overall, the crux of the problem seemed to be that users wrongly assumed they could scan any plant around them, and did not know to look for the 3D-printed plant pot locator. Although it is not clear whether this was

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because of the app design or the wording/setup of the usability test itself, it would not hurt to modify map design to make the goal clearer to users.

Prototype limitations

Due to restrictions in time for coding the prototype in Unity, the map functionality was limited. The icon indicating user location, although linked to GPS, did not coincide with real user location on the map. We were also unable to implement animations to guide the user; for example, a pulsing circle around the icon to highlight current location. The aforementioned map limitations likely contributed to user confusion over map functionality.

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HIGH PRIORITY

Overall

- Users have nowhere to go within the app when they have questions or would like to repeat the tutorial.

Map function

- Users find it difficult to understand the map. Although changes implemented in round two of testing did improve user understanding of icons, they still did not recognize that they needed to use the map to find plants.
- The lack of dynamic feedback (such as direction or orientation markers) when using the map led to user confusion.

Camera and scanning functions

- Related to map function, users need more indication to scan a specific glyph/plant pot, and not real plants around them.

AR function

- The existing glyph that triggers AR is difficult to use; users struggle to successfully activate 3D model of plant. Users need to bring their cameras unrealistically close before recognition. Most users also do not recognize the “?” as a conventional QR code, and so do not bring their cameras towards the pattern.

LOWER PRIORITY

Tutorial screens

- Users consistently attempted to interact with navigation menu during tutorial and were confused when they could not. Consider altering design of tutorial to improve user experience.

Social sharing

- Consider adding features for allowing users to share to their social media from the friends screen, as users sometimes associated friends functionality with social sharing.

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APPENDIX A: ORIENTATION SCRIPT

Hello and thank you for coming in today to this usability test for the Sprout & About app! My name is [Moderator's Name], this is [Data Logger #1's Name], and [Data Logger #2's Name] and we are the development team conducting a usability test on this app.

Sprout&About is a mobile application that uses augmented reality (AR) and mobile technology to teach users about flora found in local nature park trails. Users can collect information about plants they discover using the app and share this information with friends through social media. Although currently only a prototype within the Department of Biomedical Communications (BMC) at the University of Toronto Mississauga (UTM), Sprout&About's short-term goals are to become a campus-wide mobile application that teaches students, faculty, and UTM visitors about the flora of the surrounding area. Eventually, Sprout&About hopes to adapt its technology for more widespread use at other institutions that want to spread ecological awareness of their local flora.

The purpose of this test today is to assess (i) app navigation and app design, (ii) the augmented reality functionality, and (iii) whether the app is easy and enjoyable to use. We are hoping to solicit feedback from end users to inform changes to improve user experience for Sprout & About.

At this stage, we as a team have a developed prototype android phone app that we will be conducting our testing with today. We will be using Sprout & About on the Android phone provided. Today's test will be between 15-20 minutes. The testing will involve me asking you to complete a series of small tasks using Sprout & About. I will tell you when you can begin each task. When you believe you've completed the task, please verbally confirm with me; for example, you can say "I have completed the task." Whenever you are in the process of doing a task, please say aloud what you are thinking as you do the task. This is very helpful for our iteration process.

I may ask you to stop attempting to complete a task; if this happens, it is not a reflection of your abilities or your effort. Please stop performing that task and prepare for the next one. If any question I ask is confusing or you have trouble remembering it, feel free to ask me to repeat the question; however, I cannot give you instructions on how to complete a task once the testing has begun.

Since there are three of us watching you use Sprout&About during today's testing, we may crowd around you to get a better vantage point of the phone. It is important to note that we are not evaluating you but Sprout & About as an app, and that if any point you feel uncomfortable to continue the test, you may leave. Do you have any questions about Sprout&About or the usability test itself? Now that you have learned about Sprout&About and our usability test today, do you consent to participate in our test? ...Great! If there are no further questions, we can begin when you're ready.