

Putting the Cart Before the Horse: An Accidental Journey to Better Human-Computer Interaction

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1. INTRODUCTION

Southeastern Louisiana University's Business Research Center (BRC) developed SmartField-LA, a mobile app using deep-learning models to detect strawberry plant diseases. Users upload pictures of strawberry leaves for instant diagnostic reports. Initially, the app lacked a structured Human–Computer Interaction (HCI) design phase. This project enhances the app's usability and user experience through an iterative HCI process.

The app diagnoses diseases by capturing and interpreting images. Users upload a picture, receive a diagnostic output, and decide on care actions. SmartField-LA aims to help Louisiana strawberry farmers detect diseases early and prevent yield losses, targeting home gardeners, hobbyists, educators, and students as well. The redesign makes the diagnostic process user-friendly for both experienced farmers and casual users with limited technical or agricultural knowledge.

We built SmartField-LA before designing it, which was a bit like putting the cart before the horse. Still, it gave us something real to show while preparing for the Specialty Crop Block Grant Program. The Business Research Center developed the early version to demonstrate how technology could help Louisiana's strawberry growers detect and manage plant diseases. Having a rough prototype was better than having nothing at all. The first tests made one thing clear: even a good model fails when the interface confuses users. That lesson now shapes our plan to rebuild SmartField-LA with a focus on clarity, simplicity, and real-world use in the field.

2. NEEDFINDING PLAN

At the start of this project, I planned to use two user-based methods: a brief survey and several interviews. To conduct test surveys, I participated in over thirty-five

HCI needfinding surveys. Surveys work best when people know the interface well. Even when I answered surveys about familiar platforms like YouTube, I struggled to remember my interactions. Research shows people are not great at recalling past actions or feelings, which can lead to unreliable data. Since SmartField-LA was not public yet, users had not used the interface before. After a pilot survey with colleagues, I decided to drop the survey method and focus on in-person interviews for this project.

2.1 Interview plan

I interviewed six staff members and students at the Business Research Center (BRC), representing SmartField-LA's diverse users. Each interview lasted about twenty minutes in the BRC office garden, where I set up a simple testing environment with plants. Participants used the SmartField-LA mobile app on a test phone to simulate taking and submitting a picture for disease diagnosis.

We began with a project introduction and a warm-up chat about their comfort with mobile apps and image-based AI tools. Then, they completed the main task: capturing or uploading a strawberry leaf picture, sending it through the app, and interpreting the diagnosis. I observed their actions and took detailed notes. Afterward, I inquired about their expectations, system feedback interpretation, and the ease of understanding the diagnosis.

The interviews aimed at:

- Identify user struggles with image capture or upload.
- Evaluate the clarity of system feedback on upload success or errors.
- Assess user understanding of diagnosis results and app navigation.

I recruited participants through direct talks at the BRC and chose not to record audio to keep it natural, using written notes for key observations. Full interview scripts are in the appendix.

To conduct the interviews, we went outside at different times of the day to capture varying lighting conditions, simulating real field environment interactions. However, we could not test the app under different weather conditions, such as

rain, which remains a limitation. An important lesson learned was the difficulty of considering all variables affecting Human-Computer Interaction results, despite efforts to perform the needfinding process in context.

2.2 Heuristic evaluation plan

I conducted a heuristic evaluation of the SmartField-LA mobile interface alongside user interviews to identify design issues. The evaluation focused on the main workflow: opening the app, capturing or uploading an image, submitting it, and viewing the diagnosis. I applied three of Nielsen's heuristics: Consistency and Standards, Flexibility and Efficiency of Use, and Aesthetic and Minimalist Design (Nielsen, 1994). I assessed the consistency of visual elements and terminology across screens, the efficiency of task completion, and the cleanliness of the layout. I anticipated inconsistencies in button styles and terminology, redundant text, and potential visual balance issues on the result screen. The evaluation aimed to complement the interviews by pinpointing specific interface flaws causing the usability problems users reported.

3. NEEDFINDING RESULTS

3.1 Interview results

The needfinding phase included six in-person interviews and one heuristic evaluation of the SmartField-LA mobile app. Each interview lasted about twenty minutes in the Business Research Center's outdoor garden, using a test phone with the app to simulate real lighting conditions in strawberry fields. Participants were generally comfortable, though testing in variable weather like rain or wind was not possible.

All participants completed the main task of taking or uploading a plant picture and generating a disease diagnosis. They found the app simple, clean, and easy to navigate, with layout and icons that conveyed the task's goal without written instructions. However, some confusion arose during the picture-capture stage, as many initially pressed the "Get Diagnosis" button instead of the camera icon. The folder icon was also misinterpreted as a storage feature rather than a picture

library. Once the correct sequence was understood, all completed the task without further assistance.

System feedback during the picture upload and diagnosis phase was mostly successful. The spinner and visible uploaded image display reassured users that the app was processing their input. Fast processing was perceived as correct functioning, while slower processing led to patient waiting, indicated by the spinner.

Environmental factors like bright sunlight and glare made screen visibility challenging, with participants suggesting stronger contrasts or larger fonts for outdoor use. Despite these issues, most found the interface uncluttered and visually balanced, appreciating the simple icons and quick diagnostic report appearance after successful uploads. Overall, users valued minimal design but needed better guidance during the capture and upload steps.

3.2 Heuristic evaluation results

The heuristic evaluation supported many of the issues found in the interviews. I reviewed the same workflow using three of Nielsen's principles: Consistency and Standards, Flexibility and Efficiency of Use, and Aesthetic and Minimalist Design.

Under Consistency and Standards, the app showed minor but important design mismatches. The camera and folder icons did not follow familiar mobile patterns, so users often guessed their functions. The "Get Diagnosis" button also behaved differently from what users expected. They assumed it would open the camera, but it did not.

For Flexibility and Efficiency of Use, some users could move through the task quickly, but less tech-savvy users needed some effort. When they pressed "Get Diagnosis" before uploading a picture, nothing happened. The app missed an opportunity to guide them forward.

The Aesthetic and Minimalist Design principle was the app's strongest area. The layout was clean and visually balanced, which helped users focus on the main task. Colors and spacing were well chosen, creating a professional look. However,

important instructions placed below the icons were easy to miss, especially under bright light.

3.3 Key insights from the needfinding phase

From this needfinding phase, I gained three main insights into the user experience of SmartField-LA. First, visual clarity alone is not enough for first-time users; they also need strong action guidance during the image-capture step. Even a single misinterpreted icon can disrupt an otherwise simple workflow.

Second, environmental factors such as lighting and glare significantly shape the interaction for users. Designing for outdoor visibility use is essential for real field conditions.

Third, users link system speed to reliability. When the diagnosis or upload slowed without clear feedback, they began to doubt whether the app was working. Consistent progress indicators and clear system responses will help build confidence in the app.

4. INITIAL BRAINSTORMING PLAN

After completing the needfinding phase, I developed a plan for individual brainstorming to generate ideas for improving SmartField-LA's usability. The goal was to explore practical design alternatives.

I used a hybrid approach. I first sketched ideas on paper (well, sort of; I used my iPad's Notes app) to capture quick thoughts without filters. After the first round, I used ChatGPT to expand those ideas by entering the same core question and comparing its suggestions with my notes (see [APPENDIX D1](#)).

I aimed to produce at least twenty short ideas covering layout clarity, icon interpretation, progress indicators, and field visibility. The focus remained on improving clarity, feedback, and outdoor readability within the app's current workflow. To reduce bias, I did not evaluate or rank ideas during the initial sessions. I returned to the list after a day's break to merge duplicates, clarify wording, and remove any that required major redesigns.

5. BRAINSTORMING RESULTS

When I combined my ideas from my individual brainstorming sessions, and the ideas generated by ChatGPT, three themes stood out: clarity, feedback, and environmental adaptability. Clarity ideas included labeled icons, keeping the app clutter-free, example images, and improved navigation. Feedback ideas focused on progress indicators, confirmation messages, and clear system status. Environmental adaptability centered on a “Field Mode,” automatic brightness adjustment, and larger, high-contrast text for outdoor visibility.

5.1 Design alternative 1: improving clarity

I chose this design alternative because it tackled the key issues from needfinding and aligned with the “clarity” theme from my brainstorming. The brainstorming phase generated ideas to enhance clarity, like labeled icons, improved instruction placement, and consistent interface elements across screens. Several participants misunderstood the app’s capture and diagnosis process, often skipping instructions and pressing the “Get Diagnosis” button immediately, causing confusion when nothing happened. This highlighted another design flaw. Users required clearer initial guidance and more consistent navigation throughout the workflow.

5.2 Design alternative 2: clear labeling

Like my first design alternative, this one also stemmed from the “clarity” theme in my brainstorming and addressed a recurring issue from needfinding. Several participants were unclear about the icons on the diagnosis page, with one mistaking the folder icon for saving pictures instead of selecting an image from the library. They struggled to connect icons with their functions. Many brainstorming ideas focused on enhancing visual clarity and aligning icons with familiar mobile patterns. Adding short text labels emerged as a simple yet effective change to improve recognition without altering the layout.

5.3 Design alternative 3: step-by-step instructions

This design, like the first two, emerged from my themes of “clarity” and “feedback.” During needfinding, participants were often confused about the action sequence and subsequent steps. Some took a picture without realizing they needed to click “Get Diagnosis,” while others waited for automatic processing. My brainstorming included short tutorials, progress cues, and step-by-step instructions. A simple three-step format was the most practical choice, making the process clear and easy to follow without altering the app’s structure.

5.4 Design Alternative 4: field/dark/accessibility mode

This design alternative appeared from the “environmental adaptability” theme in my brainstorming. During needfinding, participants highlighted glare as a problem for outdoor screen visibility, and one mentioned color blindness. These issues underscored the need for improved visibility in various conditions. My ideas included high-contrast colors, bold text, and larger buttons, but a dedicated “Field Mode” proved to be the most practical solution.

6. INITIAL PROTOTYPING

I created a set of low-fidelity prototypes to visualize and test the main usability improvements for SmartField-LA. Each prototype focused on one of the themes that emerged from brainstorming: clarity, feedback, and environmental adaptability. SmartField-LA is a mobile (see Figure 1 below), screen-based app, so I used Microsoft Paint and PowerPoint to design the prototypes.

6.1 Prototype 1: guided navigation

This prototype focused on clarity and task flow. During needfinding, several users skipped the instructions and clicked “Get Diagnosis” before uploading an image. To address this, I placed the one-line instruction at the top of the diagnosis page so that users would see it first (see Figure 2). I also added Home and About buttons to the bottom of the diagnosis page to match the main screen layout and maintain consistent navigation.

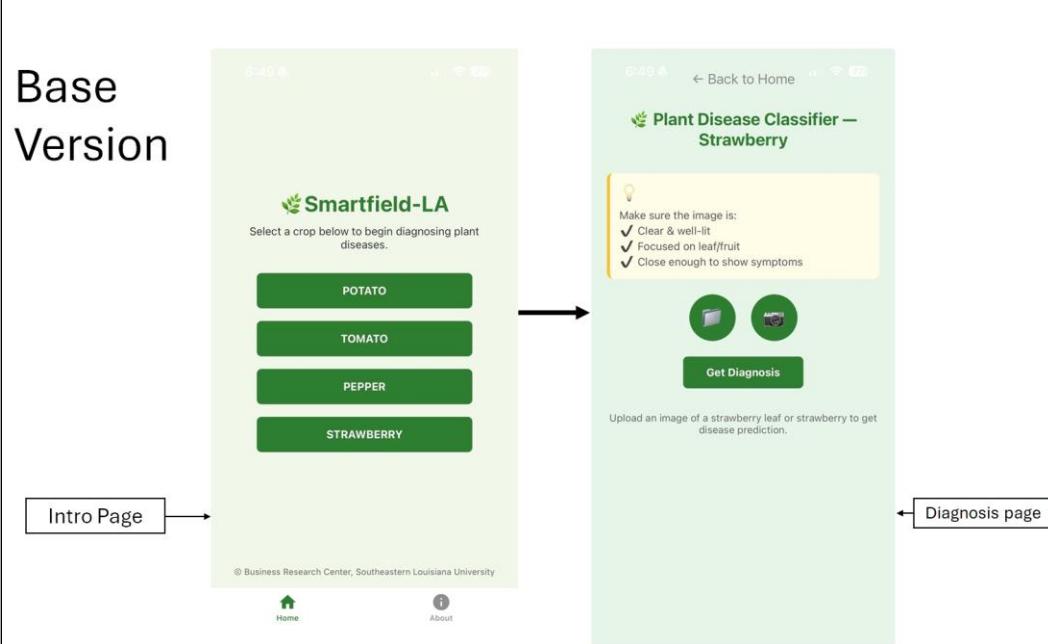


Figure 1—Current or Base version of the Smartfield-LA app.

The design followed Nielsen's principles of consistency and visibility of system status. It helped users understand where they were in the process and return home easily. These layout changes made the workflow clearer and more predictable, especially for first-time users.

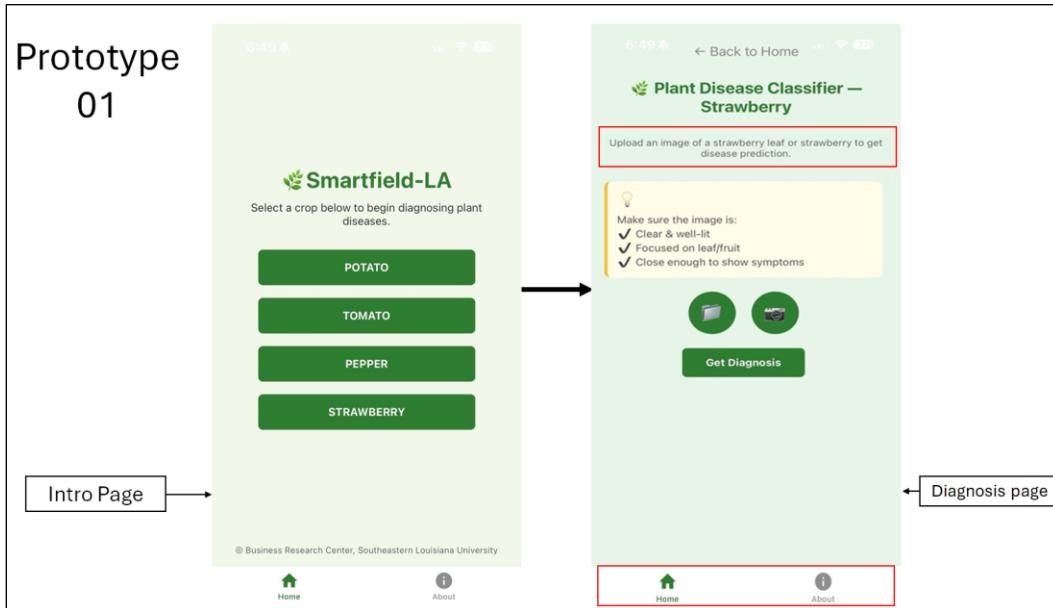


Figure 2—Prototype 1: guided capture and consistent navigation

6.2 Prototype 2: icon labels

This prototype (see Figure 3) addressed the clarity theme by improving icon recognition. During needfinding, some users were unsure what the icons meant. One participant mistook the folder icon for a save button. To fix this, I added short labels above the icons, such as “Take Picture” and “Select from Library.”

This design applied the principle of matching the system to the real world. The labels made each icon’s purpose clear, reduced hesitation, and improved the overall understanding of available actions.

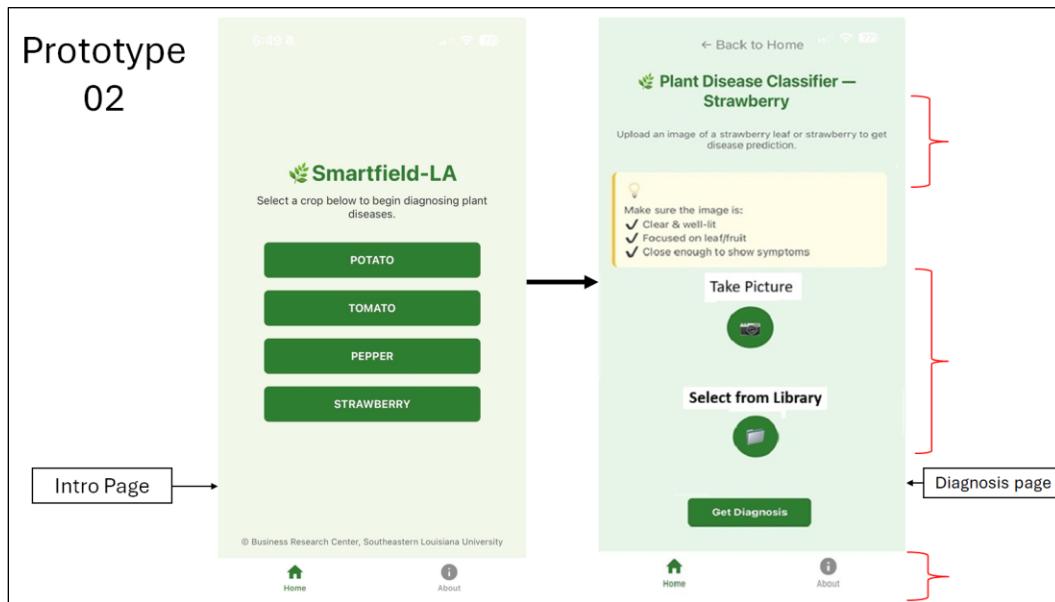


Figure 3— Prototype 2: clear labeling for icon recognition

6.3 Prototype 3: step guide

This prototype (see Figure 4) combined clarity and feedback by guiding users through the process. Several participants were unsure about the correct order of action. Some took a picture but did not realize they needed to tap “Get Diagnosis.” To fix this, I replaced the one-line instruction with a short three-step guide at the top of the page:

Step 1: Take or select a picture.

Step 2 Tap “Get Diagnosis.”

Step 3: Click “Generate Report” to view results.

The design followed the principles of visibility of system status and help and documentation by showing each step clearly on the screen. It kept users informed about what to do next, reduced mistakes, and helped them complete the process in the correct sequence.

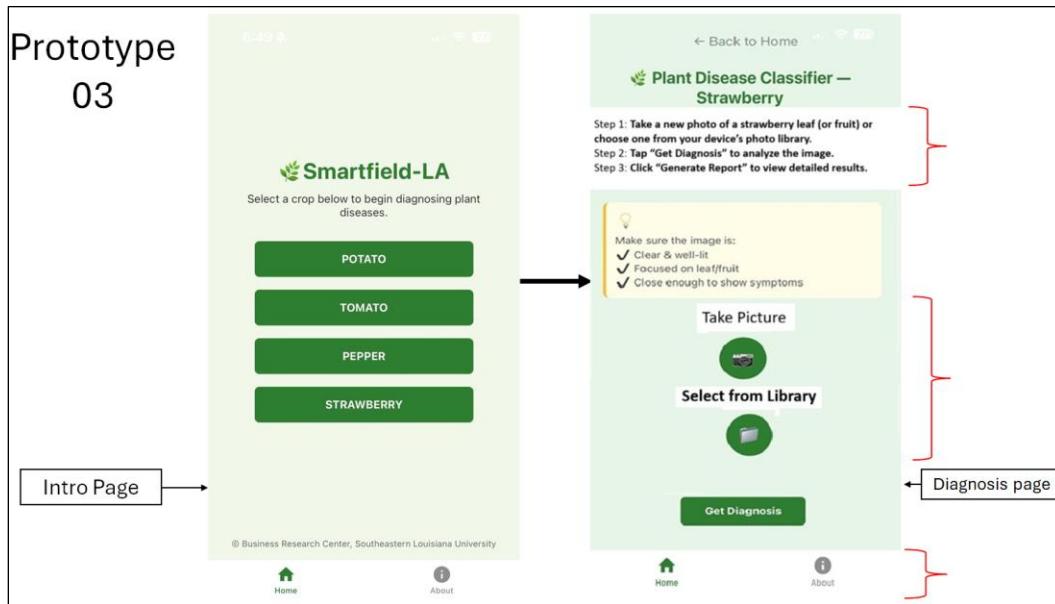


Figure 4— Prototype 3: step-by-step guidance

6.4 Prototype 4: field mode

This prototype (see Figure 5) focused on environmental adaptability. During needfinding, participants reported that glare made the screen hard to read outdoors, and one participant mentioned being color blind. To improve visibility, I created two versions of a Field Mode: one with a dark background and white text and buttons, and another with a white background, black fonts, and icons. I took participants outside in bright light conditions to compare both versions.

This prototype improved readability in sunlight and supported users with color vision challenges. It followed the principle of flexibility and efficiency of use by allowing users to switch modes based on lighting.

7. EVALUATION PLANNING

I designed an evaluation to compare the three SmartField-LA prototypes with the base version of the app. The goal was to understand how each design improved usability, clarity, and outdoor performance.

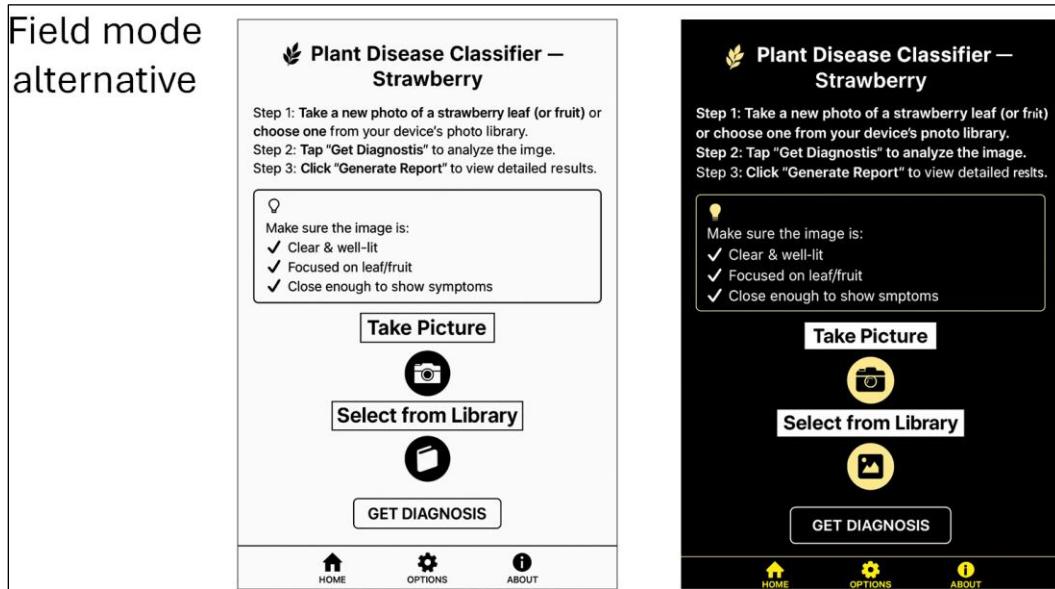


Figure 5 – field mode for outdoor and accessible use

7.1 Participants and procedure

I invited six participants who were my colleagues and graduate students in my department. All of them were already familiar with SmartField-LA and had taken part in my needfinding phase. Using the same group helped me collect consistent feedback since they already understood the app's workflow and its earlier usability issues. I scheduled individual sessions with each participant in my office. Each session lasted about twenty minutes.

I began each session by showing the base version (P0) to refresh their memory, then presented each prototype (P1: Guided Navigation, P2: Icon Labels, P3: Step Guide, P4: Field Mode) on my iPad using PowerPoint slides. For each prototype, I explained the design changes and asked three short, open-ended questions about what they liked or disliked, how it improved or failed to improve usability, and

whether they preferred it to the base version (see [Appendix B1: Evaluation Interview Questions](#)).

For the Field Mode prototype, I also asked which version (dark background with white fonts vs white background with black fonts) they preferred for outdoor use. After reviewing all designs, I asked participants to rank all four versions (P0–P3) from most to least preferred. After all prototypes were shown, I asked participants to rank all four versions (P0–P3) from most to least preferred. I followed a post-view interview method so that participants could observe the prototypes first and then share their reactions.

7.2 Qualitative analysis

I reviewed my notes and grouped participant comments by three recurring themes: clarity, feedback, and environmental adaptability (see [Appendix B2: Evaluation 1 Interview Responses](#)). Within each theme, I summarized common feedback, noted usability strengths or problems, and identified repeated suggestions as high-priority insights to guide the next iteration of design.

7.3 Quantitative analysis

The ranking data (P0–P1) provided an ordinal measure of overall preference. Because all six participants evaluated every prototype, I planned to do a Friedman (1937) test to check for differences among versions. The test is appropriate for small samples and ordinal data from within-subject comparisons. If differences appeared, I would follow up with Wilcoxon (1945) signed-rank tests to compare key pairs. I also planned to report median ranks and interquartile ranges for each prototype to show overall trends.

8. EVALUATION RESULTS

8.1 Qualitative results

I evaluated all four prototypes with six participants including my colleagues and graduate students who had also taken part in the needfinding phase. Their familiarity with SmartField-LA helped them compare the new designs against the base version more accurately. The evaluation followed a post-view interview

format, and I recorded their responses in structured notes (see [Appendix B2: Evaluation 1 Interview Responses](#)).

8.1.1 Clarity and navigation (Prototype 1)

Participants responded positively to the clearer instruction placement and the added navigation buttons. All six participants preferred Prototype 1 over the base version. They said the top-aligned instruction made the next action obvious and reduced the chance of pressing “Get Diagnosis” too early. Several participants also mentioned that the Home button improved consistency and control, making navigation more predictable.

8.1.2 Icon labels (Prototype 2)

Reactions to Prototype 2 were mixed. Four participants (out of six) preferred this version, saying that icon labels made the interface easier to interpret, especially for new users. Two participants, however, felt the labels cluttered the layout and reduced the clean look they liked in the original version. This split highlighted a tension between minimalism and clarity. While users valued information that removed ambiguity, some preferred the minimalist aesthetic once they had learned the app’s workflow.

8.1.3 Step-by-step guidance (Prototype 3)

Prototype 3 received the strongest positive feedback overall. Five participants (out of six) favored it over the base version, and most described it as the easiest to follow. They said the step-by-step instructions created a logical flow and made the process feel more guided and reliable. One participant said the white background improved legibility for color-blind users. However, one participant preferred the base version, finding the layout too busy.

8.1.4 Environmental adaptability (field mode)

When testing the two Field Mode versions outdoors, four of six participants preferred the white-background, black-text version, noting that it reduced glare and improved visibility in bright light. One participant favored the dark version, and another felt neutral between the two.

8.1.5 Cross-Prototype Patterns

Across all prototypes, three main themes stood out: clarity, feedback, and environmental adaptability. Participants said clear instructions and consistent layouts made the app easier to use. They wanted short, visible guidance and clear system responses after each action. The Field Mode results also showed the need for better visibility under bright light.

Overall, participants preferred prototypes that balanced direction with simplicity. Prototype 3 (Step Guide) was the top choice for three out of six participants, while Prototype 1 (Guided Navigation) ranked first for two participants. Both designs were praised for improving clarity without altering the familiar layout. The Field Mode feature was also seen as an important addition for real field use, offering better visibility and accessibility outdoors.

8.2 Quantitative results

Six participants ranked the four SmartField-LA versions (P0–P3) from most to least preferred. The data were analyzed using a Friedman test to compare overall rankings across prototypes. The results showed a test statistic of $\chi^2(3) = 6.8$, $p = 0.07855$ (see [Appendix B3: Friedman Test Results](#)). Although the result was not statistically significant at the 0.05 level (possibly due to the small sample size), the ranking pattern indicated clear user preferences.

Most participants ranked Prototype 3 (Step Guide) and Prototype 1 (Guided Navigation) as their top choices, while the Base Version (P0) consistently ranked lowest. The Icon Labels (P2) version received mixed responses, often placed in the middle of the rankings. These results suggest that structured guidance and consistent navigation improved user satisfaction more than visual labeling alone.

Given the small sample size ($N = 6$), the lack of statistical significance was expected. However, the trend aligns with the qualitative findings, reinforcing that users preferred prototypes offering clear instructions and consistent task flow.

9. SECOND ITERATION PLANNING

After completing the first design cycle for SmartField-LA, I had a much clearer understanding of what users need and how they think while using the app. The evaluation was extremely useful. The two interviews, one for needfinding and one for prototyping, helped me understand my participants' thought process and needs in depth. Because my prototypes were based directly on detailed needfinding interviews, each design addressed key issues found earlier. However, the evaluation also revealed that no single prototype fully met all user needs. Although this cycle did not introduce a new problem to solve, the biggest takeaway from this feedback cycle was that I needed to find a way to combine all this feedback into a single prototype. In terms of HCI principles, I needed to improve the app by offering more flexibility.

I also noticed one issue that all participants missed. Pressing the "Get Diagnosis" button still did not return any feedback if a user forgot to upload or take a picture. Rearranging the instructional text (moving it to the top) solved the issue of skipped uploads, but I still needed to address this in my final prototype.

Prototype 3 (Step-by-Step Guide) and Prototype 1 (Guided Navigation) were preferred by five participants out of six, but all three prototypes contained at least one feature that users wanted. In developing the final prototype, I planned to combine the most desired features and add an additional error-check mechanism, which was missed by users during the first prototyping sessions.

The combined design will use Prototype 3 as the base since users favored its step-by-step flow. I will retain the consistent bottom navigation from Prototype 1 to maintain clear orientation across screens and include selective icon labels from Prototype 2 to assist first-time users. The new design will also include an Options button that lets users customize the interface according to their preference, which will make the app more customizable and align with the HCI principle of flexibility and efficiency of use.

10. FINAL PROTOTYPE

To understand how far SmartField-LA has come through this study, it is useful to revisit the base version of the app (see Figure 6). The original interface had two screens: the intro page, where users selected a crop, and the diagnosis page, where the image-based disease detection occurred. For this study, I focused exclusively on strawberries. The diagnosis page revealed several design limitations during the initial needfinding phase.

The page began with picture-taking tips, which were essential for obtaining accurate results from the backend deep-learning model. While these instructions made sense from a developer's perspective, users often ignored them. During my needfinding interviews, several participants repeatedly pressed the "Get Diagnosis" button without uploading or taking a photo. Because the instructions were placed below that button, users never saw them. This reflected a wide gulf of evaluation—users could not tell what the system required before acting.

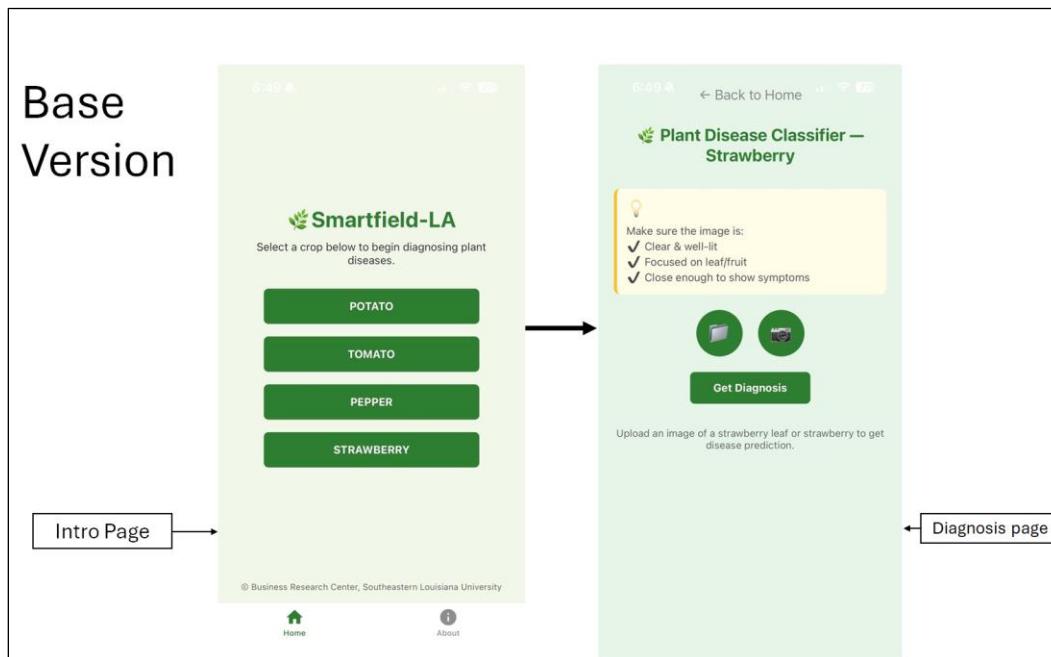


Figure 6—Current or Base version of the Smartfield-LA app.

Second, when users clicked "Get Diagnosis" without providing an image, the app gave no feedback or error message. The system failed to guide users to correct their mistakes. This created frustration and confusion, leaving them to figure out the

process on their own. From an HCI standpoint, this violated the principle of visibility of system status and lacked error prevention.

Third, several users misunderstood the icons on the diagnosis page. For example, some thought the folder icon was for saving pictures to their phone rather than uploading an image. This showed a wide gulf of execution, as the interface did not match users' mental models.

Finally, navigation was limited. Once a user selected a crop, the only way to return to the home screen was by using the small back button at the top. Some participants had difficulty finding it, showing a lack of user control and freedom.

10.1 Improvements in the final prototype

The final version of SmartField-LA combines the best features from all three prototypes and incorporates user feedback from the first evaluation cycle (see Figures 2–4 for reference). After selecting a crop, users reach the updated diagnosis page (see Figure 7). The new layout introduces three major changes, shown by curly brackets 1, 2, and 3 in Figure 7.

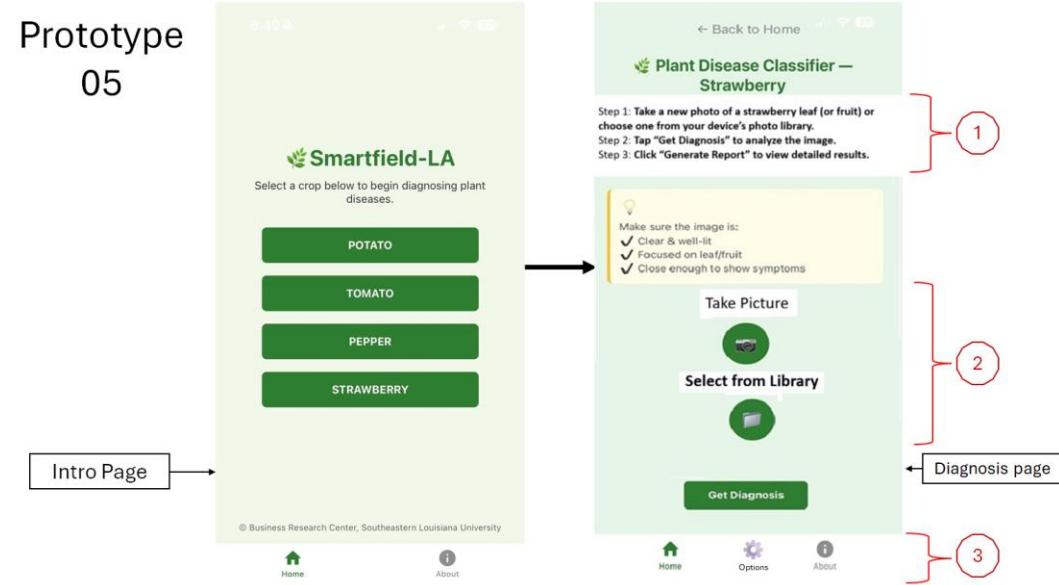


Figure 7—Final prototype.

10.1.1 Step-by-Step instructions (curly bracket 1)

At the top of the screen, a concise three-step guide walks users through the process: take or upload a photo, click “Get Diagnosis,” and view the report. This design directly addresses the earlier confusion and narrows the gulf of execution by providing clear task order. It also aligns with the principle of recognition rather than recall, since users no longer have to remember the sequence of actions.

10.1.2 Icon labels (curly bracket 2)

Text labels such as “Take Picture” and “Select from Library” appear beneath the corresponding icons. These resolve earlier misinterpretations and make each icon’s purpose clear. This change supports consistency and standards and improves learnability for first-time users.

10.1.3 Bottom navigation panel (curly bracket 3)

A new navigation bar at the bottom adds a Home button and a new Options button. The Home button gives users an alternate path for navigation, increasing user control and freedom. The Options button introduces an entirely new layer of flexibility and customization.

10.2 Enhancing feedback and flexibility

A key addition in the final prototype is the error message popup (see Figure 8). If a user clicks “Get Diagnosis” without uploading a photo, a popup appears with guidance on the correct workflow. This improvement serves two purposes: it prevents errors and provides immediate system feedback. In the previous version, users were left unsure if the app was responding. Now, the app communicates clearly, supporting the HCI principles of error prevention and visibility of system status

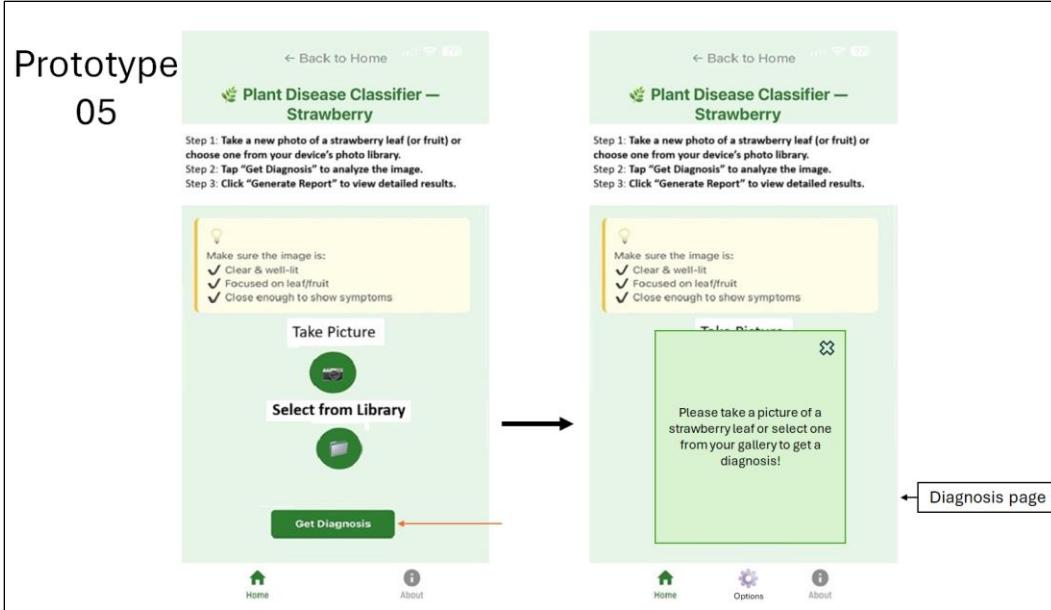


Figure 8—Final prototype with popup menu.

Clicking the Options button opens a settings box with four checkboxes: Hide Instructions, Hide Labels, Hide Tips, and Field Mode (see Figure 9). These customization features give users flexibility to tailor the interface to their needs and environment.

- Selecting Hide Instructions removes the three-step guide (see Figure 10).
- Selecting Hide Labels removes the text under the icons (see Figure 11).
- Selecting all three options simplifies the interface to its minimal form (see Figure 12). This minimalist mode reduces visual clutter and aligns with the HCI principle of aesthetic and minimalist design.

Finally, enabling Field Mode transforms the interface into a high-contrast display (see Figure 13), improving readability in sunlight and supporting users with color vision difficulties. This follows the principle of flexibility and efficiency of use, allowing adaptation to diverse field conditions.

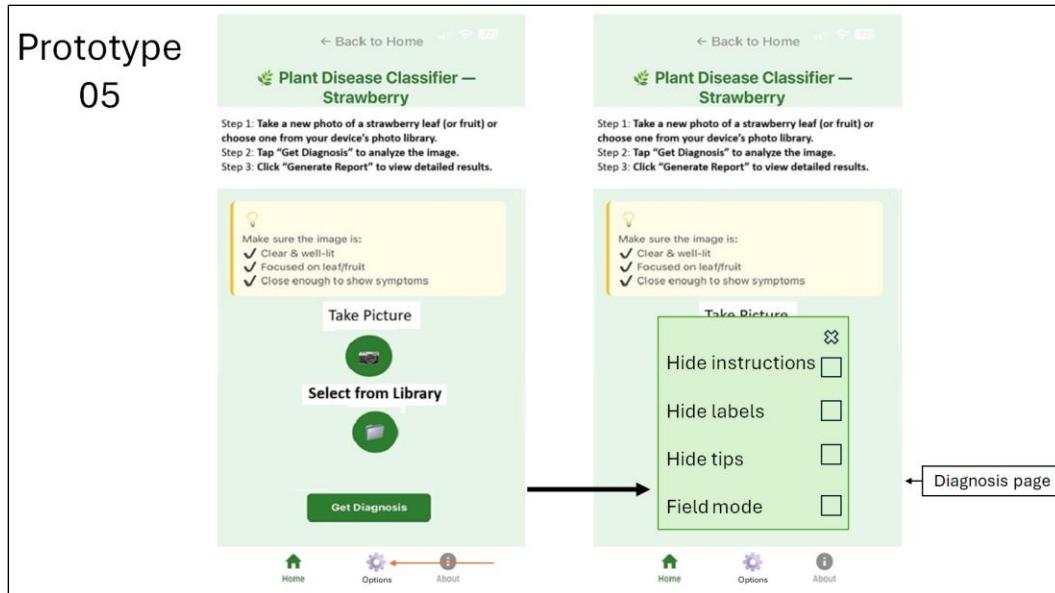


Figure 9—Final prototype with Options.

10.3 Summary

The final prototype represents a medium-fidelity combination of all previous prototypes, incorporating user feedback and grounded in HCI design principles. Each modification—from the step-by-step guide to the Field Mode—reduces user confusion, strengthens feedback, and enhances flexibility.

After developing the final prototype, I presented it individually to the same six participants who took part in the earlier evaluations. Each session included a brief walkthrough of the new features followed by open-ended feedback. This peer review step allowed me to assess how well the combined design addressed earlier usability issues and whether the new Options and Field Mode features met user expectations. The detailed responses from these sessions are discussed in the following sections of the paper.

11. VIDEO PROTOTYPE

I created a five-minute on-screen video demonstration of the final SmartField-LA prototype, which I also presented to my six participants for feedback. The video

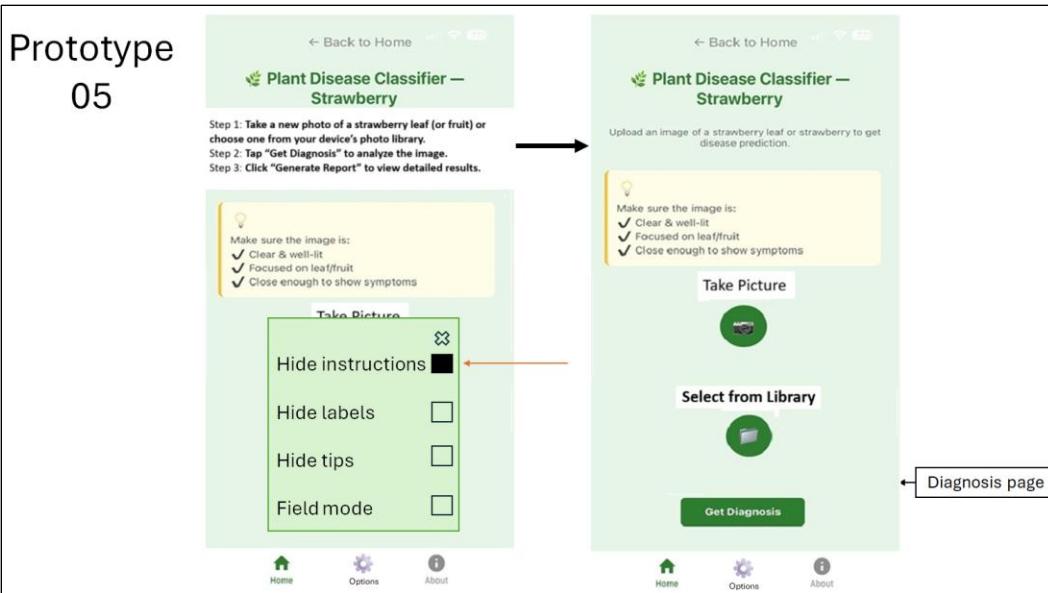


Figure 10—Final prototype with “Hide instructions” enabled

shows the medium-fidelity interface in action and follows the same walkthrough I used during their evaluation sessions.

Using screen capture, I navigate through the prototype while narrating its main features, including the three-step instruction guide, icon labels, bottom navigation

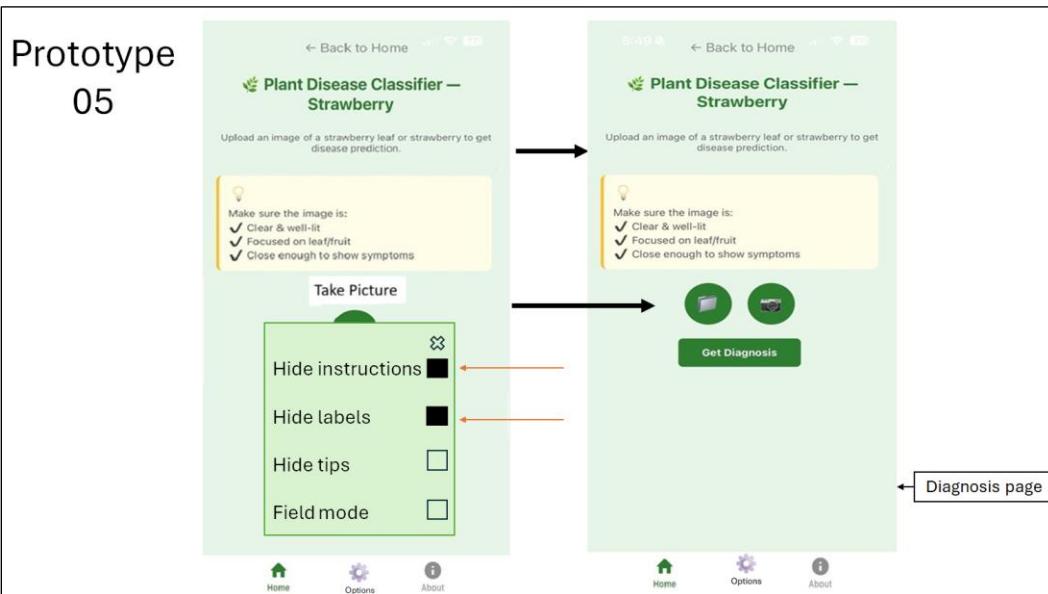


Figure 11—Final prototype with “Hide instructions” and “Hide labels” enabled

panel, Options menu, and Field Mode. I briefly explain how each feature was designed to improve usability and feedback, referencing Human–Computer Interaction principles such as recognition rather than recall, error prevention, and flexibility and efficiency of use.

The video concludes with a short reflection on how the final design combines the strengths of earlier prototypes and prepares the app for real-world field use.

The video is available on YouTube at: <https://youtu.be/xqDlxH4Av9s>

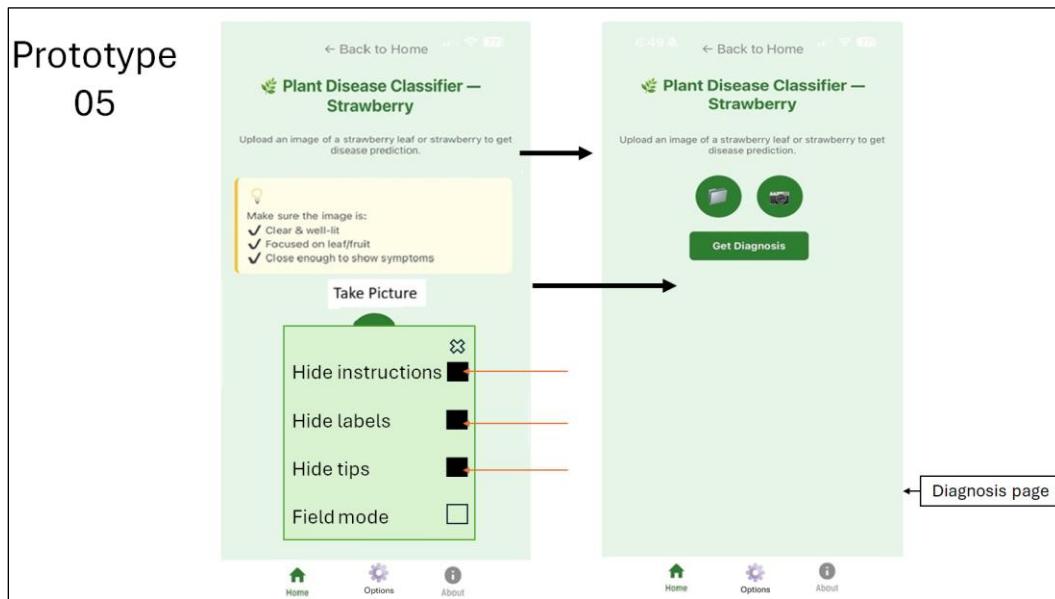


Figure 13—Final prototype with “Hide instructions”, “Hide labels”, and “Hide tips” enabled

12. FINAL EVALUATION PLANNING

For the final evaluation, I presented the combined SmartField-LA prototype to the same six participants from earlier sessions. Each session lasted about ten minutes and included a short demonstration of the final prototype followed by an interview.

12.1 Evaluation process

Participants viewed the on-screen version of the final prototype while I explained the new features such as the Options menu, Field Mode, and error message popup. After the walkthrough, I asked a short set of questions about what they liked or

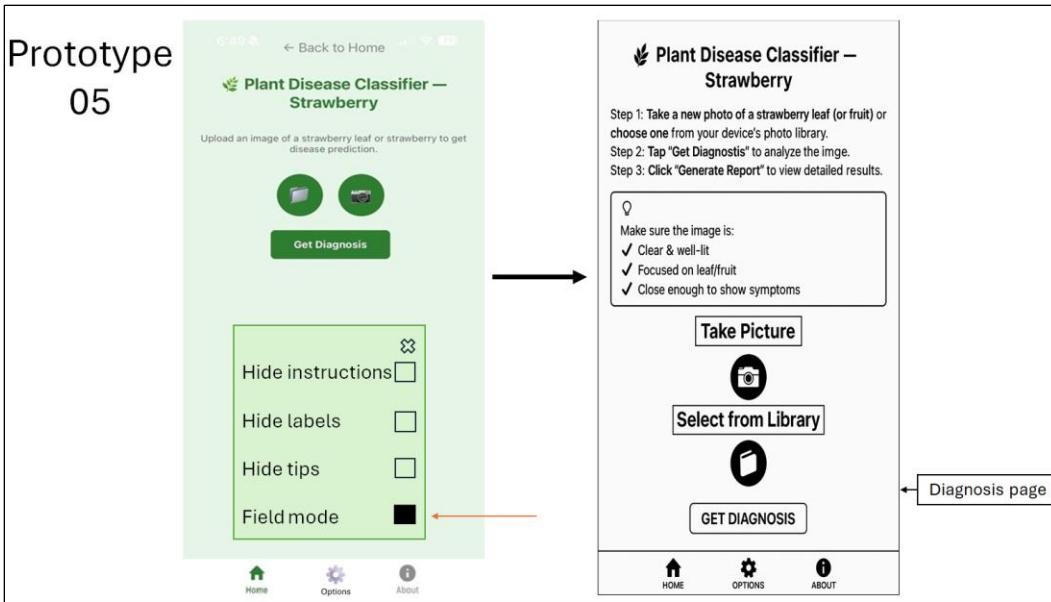


Figure 14—Final prototype with “Field mode” enabled

disliked, whether the design improved usability, and which version they preferred overall (see Appendix C1: Evaluation 2 Interview Questions). They were also asked to rank all five versions of the app: P0 = Base version, P1 = Guided Navigation, P2 = Icon Labels, P3 = Step Guide, and P4 = Combined version

12.2 Qualitative plan

For the qualitative part, I summarized the participants’ comments and grouped them by recurring themes such as flexibility, usability, and accessibility. I noted where users agreed and where their opinions differed. For example, most users liked the ability to customize the interface, while one mentioned a layout preference for icon alignment. I plan to highlight these repeated ideas and connect them with the HCI principles of flexibility and efficiency of use and consistency and standards.

12.3 Quantitative plan

For quantitative analysis, I used the ranking data (P0–P4) to measure overall preference. Since all participants ranked every prototype, I will apply a Friedman Test to check for statistical differences among the versions.

13. FINAL EVALUATION RESULTS

For the final evaluation, I tested the combined SmartField-LA prototype (P4) with the same six participants from earlier phases. Using the same group helped me compare their perceptions across the design iterations. Each participant viewed the on-screen prototype and shared their thoughts during a short interview. Sessions lasted about ten minutes each. I collected both qualitative feedback and quantitative rankings (see APPENDIX C1-C2).

13.1 Qualitative results

I analyzed interview notes and grouped participant feedback by recurring themes: flexibility, usability, customization, and accessibility.

13.1.1 Flexibility and customization

Every participant highlighted the Options menu as one of the strongest additions. Users liked being able to hide labels or instructions to create a cleaner interface once they became familiar with the workflow. Several said they would start with the full version and later switch to a minimal layout, showing how the new design adapts to both novice and experienced users.

13.1.2 Usability and feedback:

Participants praised the error message popup that appears when “Get Diagnosis” is pressed without uploading a photo. They said it made the workflow clearer and prevented confusion from earlier versions. One participant noted that the app now “feels responsive,” reflecting better visibility of system status.

13.1.3 Accessibility and aesthetics:

Most participants appreciated the Field Mode, saying the high-contrast view would help in bright light or for users with color vision challenges. Field mode successfully enhances outdoors.

13.1.4 Consistency and layout

A few participants offered minor suggestions for improvement. One mentioned that, in the minimal mode, the camera and folder icons should be side by side instead of stacked vertically. Another suggested adding a download or save option for reports. These comments will guide the next iteration of refinement.

13.2 Quantitative Results

All six participants ranked the combined prototype (P4) as their top choice. The average preference order was:

$$P4 > P3 > P1 > P2 > P0.$$

To verify whether the differences among versions were statistically significant, I ran a Friedman Test (see APPENDIX C3) for repeated measures using the participant rankings.

The test result was $\chi^2(4, N = 6) = 19.6$, $p = 0.0006$, indicating a statistically significant difference ($p < .05$) among the five prototypes.

Participants showed a consistent and strong preference for the combined prototype (P4) over all earlier versions. The result supports merging key features: step-by-step guidance, icon labels, consistent navigation, and customization, produced a more effective and user-centered design.

References

1. Friedman, M. (1937). The use of ranks to avoid the assumption of normality implicit in the analysis of variance. *Journal of the American Statistical Association*, 32(200), 675–701.
<https://doi.org/10.1080/01621459.1937.10503522>
2. Nielsen, J. (1994). Heuristic evaluation. In J. Nielsen & R. L. Mack (Eds.), *Usability inspection methods* (pp. 25–62). John Wiley & Sons.
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Appendices

APPENDIX A1: SMARTFIELD-LA NEEDFINDING INTERVIEW SCRIPT

Introduction

1. How do you usually use your phone in daily work or personal tasks?
(Who & what – opens conversation about general familiarity with mobile technology.)
2. How would you describe your first impression when you opened SmartField-LA?
(What & why – identifies initial reactions without implying approval or disapproval.)

Core Task Exploration

3. When you started taking or uploading a picture, what were you trying to do and how did you decide on your next step?
(What & how – uncovers mental models and sequence of actions.)
4. What aspects of capturing or uploading the image felt smooth, and what parts required extra effort or thought?
(How & what – examines usability and friction points.)
5. As the image was being processed, what did you notice on the screen, and what told you that the app was working?
(When & how – probes perception of system feedback.)
6. Can you describe how the app's messages or indicators helped—or did not help—you understand what was happening?
(How & why – investigates clarity and visibility of system status.)
7. Imagine using SmartField-LA outdoors on a real strawberry field. What conditions or surroundings might make the task easier or harder for you?
(Where & when – situational awareness, connects to real-world context.)

Reflection and Suggestions

8. What changes or improvements would make the picture-capture and diagnosis process more comfortable for you?
(How & why – encourages constructive input.)

Summary and Wrap-Up

9. What else stood out to you about your interaction with SmartField-LA that we haven't discussed yet?
(Open conclusion – invites final thoughts or overlooked insights.)

APPENDIX A2: SMARTFIELD-LA NEEDFINDING INTERVIEW RESEARCHER'S SCRIPT

Thanks for taking a few minutes to help with this study. Before we start, I want to explain what this session is about.

This interview is part of my project on improving the SmartField-LA mobile app. The goal is to understand how people use the app when taking or uploading pictures and reading the diagnosis results. The session will take about twenty minutes, and we'll be outside so we can see how the app works in natural light.

I'll ask you to try a few simple tasks using the app and share what feels clear or confusing. I'll be taking notes, but I won't record any audio or video. Everything you say will stay confidential and used only for research purposes.

Your participation is completely voluntary, and you can stop at any time or skip any question.

Do you have any questions before we begin? And do I have your verbal consent to continue with the interview?

APPENDIX A3: NEEDFINDING INTERVIEW RESPONSES

Handwritten notes:

<https://bit.ly/4qG4XhW>

or

<https://gtvault-my.sharepoint.com/:my?id=%2Fpersonal%2Farasool3%5Fgatech%5Fedu%2FDocuments%2FGeorgia%20Tech%2FFall%2025%2FCS6750%2FIndividual%20project%2Fneedfinding%20interview%20notes&ga=1>

1. How do you usually use your phone in daily work or personal tasks?

Interview participant 1's notes:

I use my phone to track everybody's schedule, listen to music, check kids' homework, check work emails.

Interview participant 2's notes:

I use my phone to check work calendars, check weather, call people, take pictures, and research things on google

Interview participant 3's notes:

I use my phone to check social media, emails, calls, download and listen to my favorite radio stations, and take pictures.

Interview participant 4's notes:

I literally use it as a small computer, do everything on it apart from using office apps like Word and Excel, as they need a standard keyboard. I take pictures and browse social media too.

Interview participant 5's notes:

I use it mainly for taking pictures. I also read it. I do not have many apps. I scan documents through it and listen to music.

Interview participant 6's notes:

I use it for texting, phone calls, checking weather, as a dictionary, taking pictures, emails, checking retail stores, and using it as a magnifier.

2. How would you describe your first impression when you opened SmartField-LA?

Interview participant 1's notes:

It's basic and clean. Easy to figure out what to do.

Interview participant 2's notes:

The app is clean, until the actual picture upload part. Because I could not see the instructions clearly because of the glare.

Interview participant 3's notes:

I know it's still in development phase, but the app feels user-friendly and self-explanatory.

Interview participant 4's notes:

My overall feeling was positive. It felt clean, self-explanatory, easy to use.

Interview participant 5's notes:

The app is really simple. No clutter, simple icons. I did not have to read anything. The icons were sufficient.

Interview participant 6's notes:

I felt comfortable using the app. It's graphical, no clutter, user-friendly, simple, professional, fast, and graphically balanced.

3. When you started taking or uploading a plant picture, what were you trying to do and how did you decide on your next step?

Interview participant 1's notes:

The uploading part was self-explanatory. I clicked the "Diagnosis" button first, but it did nothing, so I clicked the camera icon and after that everything was self-explanatory. It took a while to upload the picture. Also, the report generation took a while as well.

Interview participant 2's notes:

I was trying to find a wide enough area on the leaf to focus on. I was also looking for possible diseases on the leaf so that I could upload it to the app. The camera and the folder buttons were confusing. I thought the folder icon was for saving pictures to my phone.

Interview participant 3's notes:

The app just is self-explanatory. I was to follow the instructions and understood easily what to do.

Interview participant 4's notes:

The folder and camera icon lead me to press the 'Diagnosis' button, but it did nothing. I was expecting pressing the 'Diagnosis' button would open the camera, but it not. It took a few rounds of pressing the button to figure out what to do. After that, everything was straight forward.

Interview participant 5's notes:

Everything was self-explanatory. The instructions were easy to follow and took pictures effortlessly.

Interview participant 6's notes:

The user mentioned that when they were trying to take pictures, they did not notice the camera icon. They pressed the "Get Diagnosis"

button, which did not do or show anything. After pressing a few times, they realized that they needed to press the camera icon to upload pictures. The user mentioned that when they figured that out, everything was straight forward after that.

4. What aspects of capturing or uploading the image felt smooth, and what parts required extra effort or thought?

Interview participant 1's notes:

All felt smooth. I did not require any extra thought, just had to wait a little uploading the picture and getting the diagnosis.

Interview participant 2's notes:

Once I understood the task that I was supposed to take a picture of then it became easy. The placement of the instructional message was confusing though.

Interview participant 3's notes:

*Very straightforward, I did not need any extra thought or effort.
(Note: the user did not get close enough to the plant to take pictures, i.e. they did not read the picture taking tips).*

Interview participant 4's notes:

All things were intuitive. The only thing I needed to do was figure out how to take pictures. The camera icon was not very helpful to figure it out. Later, it was straight-forward.

Interview participant 5's notes:

I was surprised how fast the process was. Simple icons, and clear instructions- I needed zero effort.

Interview participant 6's notes:

I did not need any extra effort.

5. As the image was being processed, what did you notice on the screen, and what told you that the app was working?

Interview participant 1's notes:

There was a spinning wheel, which made it obvious that the app was working.

Interview participant 2's notes:

The spinner and the image I took itself were, they communicated clearly that the app is working and responsive.

Interview participant 3's notes:

The buffering or spinning wheel made it clear that the app was working.

Interview participant 4's notes:

I did not notice anything because the process was so fast. When I saw the diagnosis report I assumed the app was working.

Interview participant 5's notes:

The entire process was so fast that I understood the app worked. From uploading the picture to getting the report, everything was fast.

Interview participant 6's notes:

The picture I took was there, so I understood that the app is working. The report generated also indicated that the app was working properly.

6. Can you describe how the app's messages or indicators helped—or did not help—you understand what was happening?

Interview participant 1's notes:

I did not face any issues while I was using the app. So, I did not see messages, everything was intuitive.

Interview participant 2's notes:

Helpful The disease detection and report were very useful.

Issue: Uploading the picture part was confusing because icons were confusing. And since the instructions were below the icons, I did not go to that part (instruction part) at all.

Interview participant 3's notes:

If there was no spinning wheel, I would not understand that the app was not working. I did not understand how the app was working, the model working behind it, or how AI is working etc.

Interview participant 4's notes:

I did not need any help to understand anything, everything was self-explanatory. However, the camera icon itself did not guide me through the process, I just figured out myself what I am supposed to do.

Interview participant 5's notes:

At the beginning, I was confused: do I need to hit the diagnosis button first or the camera icon? After clicking on the 'Get Diagnosis' button, nothing happened so I figured out I need to press the camera icon.

Interview participant 6's notes:

The instructions were so clear and helpful that I did not have to think at all. I was passive entire time. The picture, the report, everything was clear and helped me understand, everything came to me organically.

7. Imagine using SmartField-LA outdoors on a real strawberry field. What conditions or surroundings might make the task easier or harder for you?

Interview participant 1's notes:

The hardest part of using the app for me was focusing on one leaf, there are so many leaves as well as weeds. So, I guess that might be a problem in the field.

Interview participant 2's notes:

Sunlight (because of the screen glare), weather (rain, wind etc.), lightning (glare)

Interview participant 3's notes:

Time of the day, like sunrise or sunset. It would affect the quality of the pictures. Other environmental factors like rain, or do not walk in the field.

Interview participant 4's notes:

The user was expecting their picture library besides the camera when the camera opened via the app. Because that's what android users see, but the test phone was an iPhone. iPhones only show the picture target, not the library. The user highlighted common environmental factors like rain and wind could create some issues using the app in the field.

Interview participant 5's notes:

I was confused about the number of pictures I am supposed to take. Should I take one or multiple pictures. If I take multiple pictures, does the new one override the earlier one? I would say taking pictures in the sun might be a little difficult because of the screen glare.

Interview participant 6's notes:

Lighting, raining, weather, wind, internet connection.

8. What changes or improvements would make the picture-capture and diagnosis process more comfortable for you?

Interview participant 1's notes:

It was a very comfortable experience for me; the app is very easy to understand. I would not change anything.

Interview participant 2's notes:

I would rearrange the instructional texts. The folder icon did not make sense. Browsing camera or library or uploading pictures would be a better way to describe its functionality instead of the folder icon.

Interview participant 3's notes:

The app was user-friendly, even a eighth graders would be able to use, so there were no suggestions.

Interview participant 4's notes:

If I click the 'Get Diagnosis' button before taking a picture or selecting from my library, I want to see two options after clicking the 'Get Diagnosis' button: Take a picture or upload from library.

Interview participant 5's notes:

Nothing to add.

Interview participant 6's notes:

The 'upload the image's instruction should be at the top, not at the bottom. What the folder icon does was not clear to me. I was confused if the folder icon was for saving the picture in my phone. I did not predict that the button would take me to my picture library.

9. What else stood out to you about your interaction with SmartField-LA that we haven't discussed yet?

Interview participant 1's notes:

The only issue for me was that the app was slow in uploading and getting diagnosis.

Interview participant 2's notes:

No additional comments.

Interview participant 3's notes:

I am just fascinated by how technology is evolving.

Interview participant 4's notes:

The report generated by the app was nice, I love that feature of the app.

Interview participant 5's notes:

I am really surprised how fast the app is. I also like how clutter-free apps are. I would add clear instructions on the steps so that I would not press the 'Get Diagnosis' button first without uploading the picture.

Interview participant 6's notes:

No additional comments.

APPENDIX B1: EVALUATION 1 INTERVIEW QUESTIONS

For each prototype (P1–P4):

1. Based on the description I just provided and the slide demonstration, what did you like or dislike about this prototype?
2. How did this prototype improve or not improve the usability of the app?
3. Compared with the base version, would you pick this prototype or prefer the base version?

For Field Mode (P4) only:

4. Which version do you prefer—black and white or black and yellow—and why?

Please rank all four versions from most preferred to least preferred.

- P0 = Base version
- P1 = Guided Navigation
- P2 = Icon Labels
- P3 = Step Guide

APPENDIX B2: EVALUATION 1 INTERVIEW RESPONSES

HANDWRITTEN NOTES

https://gtvault-my.sharepoint.com/:b/g/personal/arasool3_gatech_edu/ERvEks0rJ_5Cm073FB5Zl8oBt2mdt7LXqZTpvDhMS6a6Lg?e=pmNu24

or

<https://b.gatech.edu/4oPdrBx>

PROTOTYPE 1

Interview participant 1's notes:

I liked this prototype over the base version. Because the instructions are clearer. Moving them at the top makes a lot of sense, now I can see what I need to do. I would say prototype 1 is better than the base version ($P1 > P0$).

Interview participant 2's notes:

This version is much more user-friendly and precise. It tells you what to do. Although a minor adjustment, I would choose Prototype 1 over the base version ($P1 > P0$).

Interview participant 3's notes:

Prototype 1 over the base version because instructions are better. The Home button option also adds the option to go back. If I clicked a different crop by accident, or wanted to check a different crop, I could go back using the Home button at the bottom of the page, so $P1 > P0$.

Interview participant 4's notes:

Putting the instruction at the top make it clear that I should upload or take a picture first. The Home button at the bottom makes it easier to go back. $P1 > P0$.

Interview participant 5's notes:

Instructions at the top make it clearer although I did not have any trouble using the app. I would like Icons in green though, it looks more aesthetic. I would prefer prototype 1 over the base version (i.e. P1>P0).

Interview participant 6's notes:

The instructions at the top made them more visible. Putting the Home button in the bottom panel made the app more consistent with the Home page. I like Home/About button because: it's more consistent, more visible. The icons are also helpful. I would obviously take prototype 1 over prototype 0 or the base version.

PROTOTYPE 2

Interview participant 1's notes:

The labels are helpful and better of course, but font size should be smaller and not in white. I would pick prototype 2 over the base version: P2>P0.

Interview participant 2's notes:

I like the labels as they remove the guessing part. I would pick this version over the base version. (P2>P0)

Interview participant 3's notes:

The users like the labeling of the icons. It removes some of the minimalistic look which the user preferred, but the user felt it gives necessary information. So, P2>P0.

Interview participant 4's notes:

The user felt labels are useful, but they wouldn't need them. The user preferred the base version over prototype 2: P0>P2.

Interview participant 5's notes:

The labels are helpful; I would pick this prototype over the base version: P2>P0.

Interview participant 6's notes:

I think I already have enough information from the top, so I do not need the labels. I like minimalistic base version over this prototype: P0>P2.

PROTOTYPE 3

Interview participant 1's notes:

Easy choice for me, I would choose P3 over the base version because I think step-by-step instructions are very useful.

Interview participant 2's notes:

I think this (prototype 3) is useful for general audience. It would capture all the audience irrespective of their tech savviness. Of course, P3>P0.

Interview participant 3's notes:

This prototype (P3) feels overly verbose. I think it lost all the minimalism, which I liked. Showing step-by-step instead of all the steps together (in the base and P1) feels cluttered. But I would still pick this over the base version of the app: P3>P0.

Interview participant 4's notes:

This (prototype 3) is way better than the base version especially for a color blind user. The instructions on white background made it super easy for me to notice the instructions. I also like the detailed instructions. Very easy choice for me P3> P0.

Interview participant 5's notes:

The step-by-step instructions are helpful over not instruction, or instructions at the bottom, because I missed the one-liner instruction in the base version. So, easy decision: P3>P0.

Interview participant 6's notes:

I prefer the base version over this (prototype 3). There is too much information, it does not look clean, and it looks clunky. So, P0>P3.

FIELD MODE

4. Which version do you prefer—white background-black fonts versus black background-white fonts—and why?

Interview participant 1's notes:

White background helped me to reduce screen glare.

Interview participant 2's notes:

White background helped me to reduce screen glare.

Interview participant 3's notes:

White background helped me to reduce screen glare.

Interview participant 4's notes:

I am a big dark mode fan, so I would choose the black background and white fonts.

Interview participant 5's notes:

White background helped me to reduce screen glare.

Interview participant 6's notes

I am indifferent, both look the same to me.

5. Please rank all four versions from most preferred to least preferred.

- P0 = Base version
- P1 = Guided Navigation
- P2 = Icon Labels
- P3 = Step Guide

Interview participant 1's notes:

$P3 > P2 > P1 > P0$

Interview participant 2's notes:

$P3 > P2 > P1 > P0$

Interview participant 3's notes:

$P2 > P1 > P3 > P0$

Interview participant 4's notes:

$P3 > P1 > P2 > P0$

Interview participant 5's notes:

$P1 > P2 > P3 > P0$

Interview participant 6's notes:

$P1 > P0 > P2 > P3$

APPENDIX B3: FRIEDMAN TEST RESULTS

The Friedman Test for Repeated-Measures

Success!

Explanation of results

The output of this calculator is pretty straightforward. The values of the Friedman χ^2_r statistic and p appear at the bottom of the page. If the text is blue, your result is significant; if it's red, it's not. The only thing that might catch you out is the way that we've rounded the data. The data you see below, which provide details about the calculation, have been rounded. However, we did not round when actually calculating the values of χ^2_r and p . This means that if you try to calculate these values on the basis of the summary data provided here, you're likely going to end up with a slightly different - and less accurate - result.

Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
4	3	2	1	
4	3	2	1	
4	2	1	3	
4	2	3	1	
4	1	2	3	
2	1	4	3	

Ranks T1	Ranks T2	Ranks T3	Ranks T4
4	3	2	1
4	3	2	1
4	2	1	3
4	2	3	1
4	1	2	3
2	1	4	3

Sum: 22	Sum: 12	Sum: 14	Sum: 12
---------	---------	---------	---------

The χ^2_r statistic is 6.8 (3, $N = 6$).

The p -value is .07855.

The result is *not* significant at $p < .05$.

Calculation Summary

$$\chi^2_r = (12/(nk(k+1)) * (\sum R^2) - 3n(k+1)$$

$$\chi^2_r = 0.1 * 968 - 90$$

$$\chi^2_r = 6.8$$

APPENDIX C1: EVALUATION 2 INTERVIEW QUESTIONS

For each prototype 4:

5. Based on my presentation, what did you like or dislike about this prototype?
6. How did this prototype improve or not improve the usability of the app?

For Field Mode (P4) only:

7. Which version do you prefer—black and white or black and yellow—and why?

Please rank all four versions from most preferred to least preferred.

- P0 = Base version
- P1 = Guided Navigation
- P2 = Icon Labels
- P3 = Step Guide
- P4 = Combined version

APPENDIX C2: EVALUATION INTERVIEW NOTES

INTERVIEW NOTES:

[HTTPS://BIT.LY/3WBCL2A](https://bit.ly/3WBCL2A)

OR,

[HTTPS://GTVault-](https://gtvault-)

MY.SHAREPOINT.COM/MY?ID=%2FPERSONAL%2FARASOOL3%5FGATECH%5FEDU%2FDOCUMENTS%2FGEORGIA%20TECH%2FFALL%2025%2FCS6750%2FINDIVIDUAL%20PROJECT%2FEVALUATION%202%20NOTES%2EPDF&PARENT=%2FPERSONAL%2FARASOOL3%5FGATECH%5FEDU%2FDOCUMENTS%2FGEORGIA%20TECH%2FFALL%2025%2FCS6750%2FINDIVIDUAL%20PROJECT&GA=1

PROTOTYPE 4

Interview participant 1's notes:

As a repeat user, I love the options to eliminate the labels. I might need the labels or the instruction for the first couple of times; I would use the option menu to make the app clutter free. This version is definitely better than any other previous versions. My rating would be: P4>P3>P2>P1>P0

Interview participant 2's notes:

I like this version overall. After using it a few times I would prefer the most minimalistic version of the app. So, my ranking:

P4>P3>P2>P1>P0

Interview participant 3's notes:

It looks very busy at the beginning, but I like how I can make it a minimalistic version using the options. However, I think there is some consistency issue. The minimalistic version camera and folder option are in a column; I would prefer them to be side-by-side.

Overall, I like this version over the previous versions.

(P4>P2>P1>P3>P0)

Interview participant 4's notes:

Pretty straightforward, everything I need is present in the app. I would love to have the option to download or save generated reports.

This version is better than previous versions.

P4>P3>P1>P2>P0

Interview participant 5's notes:

I like the option button to remove the extra info. On the accessibility point this is brilliant. I think the app is now user-friendly for all types of people. This is the best version so far. P4>P1>P2>P3>P0

Interview participant 6's notes:

I like the message shown after clicking the 'Get Diagnosis' button if I click it without taking or uploading a picture. Options are terrific, it allows everyone to be a user. But I might not use the Options at all. I usually don't spend enough time on any apps to learn more about their functions or options. My ranking: P4>P3>P1>P2>P0

APPENDIX C3: FRIEDMAN TEST RESULTS

The Friedman Test for Repeated-Measures

Success!

Explanation of results

The output of this calculator is pretty straightforward. The values of the Friedman χ^2_r statistic and p appear at the bottom of the page. If the text is blue, your result is significant; if it's red, it's not. The only thing that might catch you out is the way that we've rounded the data. The data you see below, which provide details about the calculation, have been rounded. However, we did not round when actually calculating the values of χ^2_r and p . This means that if you try to calculate these values on the basis of the summary data provided here, you're likely going to end up with a slightly different - and less accurate - result.

Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
5	4	3	2	1
5	4	3	2	1
5	3	2	4	1
5	3	4	2	1
5	2	3	4	1
5	3	4	2	1

Ranks T1	Ranks T2	Ranks T3	Ranks T4	Ranks T5
5	4	3	2	1
5	4	3	2	1
5	3	2	4	1
5	3	4	2	1
5	2	3	4	1
5	3	4	2	1

Sum: 30	Sum: 19	Sum: 19	Sum: 16	Sum: 6
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The χ^2_r statistic is 19.6 (4, $N = 6$).

The p -value is .0006.

The result is significant at $p < .05$.

Calculation Summary

$$\chi^2_r = (12/(nk(k+1)) * (\sum R^2) - 3n(k+1)$$

$$\chi^2_r = 0.067 * 1914 - 108$$

$$\chi^2_r = 19.6$$

APPENDIX DI: INDIVIDUAL BRAINSTORMING

Paper brainstorming notes:

<https://bit.ly/490c6U6>

or

https://gtvault-my.sharepoint.com/:b/g/personal/arason3_gatech_edu/EbEvJ1RdM4VKpje1LPBdmAkBFH7FZhL7WrODiExMgoNaKw?e=9D9CPh

ChatGPT prompt and response

> I am conducting an individual brainstorming session for my Human–Computer Interaction project. The project focuses on improving the usability of **SmartField-LA**, a mobile app developed by Southeastern Louisiana University’s Business Research Center (BRC) that detects **strawberry plant diseases** using deep-learning image analysis.

>

> I am not designing a new interface from scratch. My goal is to **improve the existing SmartField-LA mobile interface** to make it clearer, faster, and easier to use for real users such as farmers, gardeners, and students.

>

> **Task:**

> Generate at least **20 short, specific, and practical ideas** for improving the usability of SmartField-LA based on real-world use in the field. Focus on:

>

> * Visual clarity and icon meaning

> * Progress feedback and system status

> * Diagnosis readability and interpretation

- > * Outdoor visibility and field usability
- > * Error prevention and user guidance
- >
- > **Constraints:**
- >
- > * The app must remain a **mobile image-based tool**; no new interaction types like gesture or voice input.
- > * All ideas must be **feasible within the current app framework** (Android/iOS).
- > * Avoid suggestions that require new hardware or major redesigns.
- >
- > **Approach:**
- >
- > * First, list as many ideas as possible without evaluating them.
- > * Then, group similar ideas into categories if patterns emerge.
- > * Keep each idea to one or two sentences maximum.
- >
- > Finally, number the ideas (1–20 or more) and keep them concise enough for later synthesis into three design alternatives.

Here are **25 concise and practical usability improvement ideas** for **SmartField-LA**, grounded in real field conditions and aligned with HCI principles like visibility of system status, error prevention, and match between system and real world.

Brainstorming Results: SmartField-LA Usability Improvement Ideas

Visual Clarity & Icon Meaning

1. Replace abstract icons (e.g., cloud upload) with context-specific ones such as a **camera + leaf** to signify “Upload Leaf Photo.”
2. Add **hover or tap labels** showing icon meaning (e.g., “Capture Leaf Image”).
3. Use **color contrast that meets WCAG outdoor readability standards**—dark text on light matte backgrounds.
4. Introduce a **“Field Mode” toggle** that automatically boosts contrast and enlarges font for sunlight visibility.
5. Simplify layout by displaying only essential buttons during diagnosis—reduce visual clutter.

Progress Feedback & System Status

6. Add a **progress bar** showing upload, analysis, and result generation stages.
7. Include a **dynamic status message** such as “Analyzing leaf texture (Step 2 of 3)” to reduce user uncertainty.
8. Provide a **brief success confirmation** (“Diagnosis complete! View report below”).
9. Add a **time estimate** (e.g., “~8 seconds remaining”) for model processing.
10. Show an **offline indicator** when the internet connection is lost, with retry instructions.

****Diagnosis Readability & Interpretation****

11. Display **clear headings** like “Detected Disease” and “Suggested Action.”
12. Use **color-coded diagnosis cards** (green = healthy, yellow = mild infection, red = severe).
13. Add **small icons** representing symptoms (e.g., leaf spots, curling) beside each diagnosis label.
14. Provide **plain-language summaries** below technical disease names (e.g., “Gray Mold – a common fungal infection”).
15. Offer a **“Learn More” expandable section** linking to management advice.

****Outdoor Visibility & Field Usability****

16. Introduce a **large capture button** with haptic feedback for gloved use.
17. Add an **auto-brightness adjustment** that increases display visibility outdoors.
18. Implement a **“Quick Retake” button** if the photo is blurry or shadowed.
19. Include a **battery-saving mode** for long field sessions.
20. Allow **one-tap zoom preview** after capture to verify clarity before upload.

****Error Prevention & User Guidance****

21. Add **pre-upload quality checks** warning users if the image is blurry, too dark, or out of focus.
22. Show **example good/bad photos** before capture to guide users.
23. Provide **context-aware prompts**, such as “Try a single leaf on a plain background.”

24. Include **undo or cancel options** for uploads without restarting the session.
25. Log the **last three successful diagnoses** so users can revisit results if needed.