Streamlined Camera Mode Selection in iOS

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Abstract—To do

1. INTRODUCTION

In this project, I study the task of camera mode selection on the iPhone. I spent several months this year visiting touristy cities and observed dozens of users struggle with the interface. For example, at landmarks, I have observed users take a video instead of a photo, get confused when the panorama instruction screen appeared, and use one mode when another might better fit the context. For more spontaneous events (e.g., street performances), I have seen users take too long to switch to video mode and start recording. These difficulties can prevent them from achieving their goal of capturing a memory.

I also have firsthand experience helping others with these challenges. For weeks after my grandma got her first iPhone, I had to remind her how to switch between taking photos and videos and help her get back to photos after accidentally switching to another mode. Moreover, my parents had no idea about several other modes (slo-mo, cinematic, time-lapse, etc.) until they saw me using them. Even when they *knew* those modes existed, they were not sure how to access them until I showed them. There are still modes that they simply do not understand.

Finally, even as an experienced user, I have my own problems with the current interface. I often accidentally tap the screen or swipe it a certain direction, which changes the camera mode to one that I do not want. To access certain modes, I have to swipe through all the others. The mode labels are small and hard to read, especially in bright conditions. Generally, these are only minor annoyances that waste a few seconds. However, in certain contexts, these lost seconds can cause me to miss the moment.

All these experiences made me realize that there are ways the interface could be tweaked (or even redesigned) to make it more useful and usable. This project will study the way that users select the camera mode through the inter-

face, where they experience discomfort, and how it might be changed to make the interface more invisible.

2. NEEDFINDING

2.1. Needfinding Plan

Before any needfinding exercises, I first need an understanding of the data I want to gather, the questions I want to answer. Thus, I create a data inventory to which I will relate the needfinding activities:

· Who are the users?

· Where are the users?

· What is the context of the task?

· What are their goals?

· What do they need?

· What are their tasks?

· What are their subtasks?

· What are users' difficulties with the current interface?

· Are there any accessibility needs?

Then, to understand the basics of the task, the users, and their behavior, I will start with naturalistic observation. The population of interest here is iOS users. I am currently in a large and touristy city, so the naturalistic observation will include a variety of user types and contexts. I will also use participant observation to familiarize myself with the interface.

With the qualitative insights from observation, I will survey users to understand their experiences with the current interface. I will recruit family and friends through email and classmates through class forums. It concerns experiences with the current interface, so for this exercise, I will invite iPhone users. Appendix 8.2 lists the specific survey questions.

Finally, I will conduct a heuristic evaluation of Apple's current camera mode interface. Specifically, I will focus on the heuristics of discoverability, ease and

comfort, and equity, three areas where I find the current interface has limitations. Combined with the other needfinding techniques, the results of the heuristic evaluation will highlight specific areas where users struggle and indicate a general direction for improving the interface.

2.2. Needfinding Results

2.2.1. *Naturalistic Observation*

I observed a wide range of demographics (such as age groups) and contexts, including interactions at monuments, with street performers, selfies, family photos, etc.. Eight interactions stood out to me. Appendix 8.1 includes the raw observations.

Starting from the individual operators and abstracting up, I noticed three trends: accidental mode switching, difficulty switching modes, and difficulty recognizing which mode was selected. These problems were most prevalent in sunny conditions, when the sun made it harder for users to see the screen.

First, users would *accidentally* switch modes. For example, I noticed one person accidentally swipe to a different mode when trying to zoom. Second, users had difficulty *switching* modes. More often than not, they had to stop what they were doing and bring the phone to their face to make sure they were choosing the right mode.

Even doing so, they also occasionally tapped the *wrong* mode, which then caused some confusion or time to recover. Finally, it was hard for users to recognize which mode was selected, perhaps because of the small buttons or lack of other feedback to indicate their current mode.

2.2.2. *Participant Observation*

I also paid closer attention to my usage. There were occasions that I accidentally switched the camera mode, especially when trying to zoom in one-handed use. I also switched to the *wrong* mode due to the small button sizes. The screen is not tolerant of errors: I had to be conscious and precise with my taps.

Besides these errors, I noticed slowness, particularly from excessive taps. There were times I had to tap through multiple modes to reach my target, despite be-

ing a single mode switch. There was also discomfort from the small size of the buttons and labels.

2.2.3. *Survey*

There were 28 responses to my survey from a diverse range of ages and levels of experience. Appendix 8.3 summarizes the results. The self-reported experience levels were 61% proficient, 18% competent, 14% advanced, and 7% novice. Most users tap the screen (68%) to navigate modes compared to swiping (32%). Photo, video, and portrait are the most frequently used modes, used by 100%, 93%, and 64% of users, respectively. 14%, 11%, 7%, and 4% of participants frequently use pano, time-lapse, slo-mo, and cinematic, respectively.

85% of participants have accidentally captured media in the wrong mode, further indicating a lack of awareness of the current mode. 78% of participants have missed a photo/video opportunity due to difficulties switching to their desired mode, providing more evidence of slowness. Finally, 32% of users feel overwhelmed by the number of camera mode options.

When asked to pick one from a list of aspects they would like to change, the top choices (all tied at 18%) were "Easier to locate and select the right mode," "Customizability (i.e., ability to rearrange modes)," and "Faster mode switching."

2.2.4. *Heuristic Analysis*

Discoverability

The discoverability heuristic recommends that relevant functions should be visible so that the user can discover them and figure out what to do. As the anecdote about my parents indicates, the current interface has limitations. Figure 1 shows the current interface. The small bar at the bottom, which itself is not very noticeable, shows the name of five camera modes. There are two more modes, "Time-Lapse" and "Slo-Mo" on the far left that the user cannot see unless they switch to the camera modes on the left, a feature that is not obvious or made clear to the user.

Instead, the interface might list all camera modes in one screen. This may compete with simplicity, however, so the interface could instead make it clearer that there are more options than what is shown (perhaps by using a **signifier** to indicate permissible actions such as an arrow, a "…", or some other common in-

dicator). They could also change the method of selection altogether and replace the carousel with another interface that improves feature discoverability.
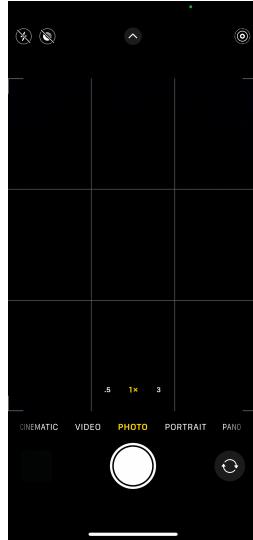

Figure 1—Current iOS camera interface

Moreover, it is difficult to tell what each mode does without recognizing the function by name or reviewing the media after capturing it. A strong design choice was the use of photography terms ("Photo," "Video,"), which clearly indicates their functions. However, others are unclear, especially for users without photography knowledge (e.g., "Pano," "Portrait"). The interface could include some **representations** to help users map the interface to reality.

Ease and Comfort

The interface also struggles with the ease and comfort heuristic, that the design can be used efficiently and comfortably and with a minimum of fatigue, providing appropriate size and space for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility. Recall the camera mode carousel in figure 1: the menu and mode labels are small, and the buttons are cramped. The cramped design makes the interface less readable and comfortable to use, which can lead to user misclicks and errors.

The ability to swipe left and right to switch between modes alleviates this issue by adding flexibility but introduces another. It is easy to swipe, but it is also easy to *accidentally* swipe and unintentionally switch camera modes. Finally, switching between modes at the edges can be time-consuming. For example, to

switch from "Time-Lapse" to "Pano," the user must pass through all the modes in between, which requires a *minimum* of six swipes or three taps.

Equity

Under equity, the interface should allow every user to use the system the same way and have the same user experience. The only way to switch between camera modes is to tap the small labels on the carousel (see figure 1) or swipe left/right. The aforementioned issues with discoverability may exclude novices who are unfamiliar with the functionality of each camera mode, and the issues with ease and comfort may exclude users with visual or motor impairments. I especially notice this with my grandma: she does not understand the other camera modes, and the cramped layout is hard for her to read and use.

2.2.5. *Needfinding Insights*

The three needfinding exercises indicate four key problems with the current interface: difficulty reading and pressing mode buttons because of the small size, accidental mode switches, difficulty recognizing the current mode, and slowness from having to tap through other modes before the desired mode.

3. BRAINSTORMING

3.1. Brainstorming Plan

With the understanding of the task and user needs from the needfinding activities, it is time to consider design alternatives. I need to explore the design space of the problem. I will start with the core problem: iOS camera mode selection.

Perhaps the most prevalent bias in brainstorming is the **anchoring bias**: we might focus too heavily on our first idea, which can cause narrow thinking and missed opportunities. Thus, I will start with divergent thinking, simply recording every idea that comes to mind. In the early stages, I want to focus on the *volume*, not the quality of ideas. My goal is at least 20 ideas with at least five unique methods of interaction. This process will also mitigate **confirmation bias**: the number of ideas will force me to think beyond my pre-existing ideas.

A related bias is a sort of **status quo bias**. We might prefer traditional ideas and reject novel ones simply because we fail to think creatively or do not think they are as practical. I will require myself to consider at least five ideas that use non-

traditional interaction methods or are currently impractical to implement. Then, after generating all my ideas, I will look for similarities and group them into potential categories to move to the design alternatives phase.

Finally, I will repeat this process with a generative AI and the same requirements I set for myself. AI support will enhance my ability to generate and organize ideas, and repeating the brainstorming process will help me identify new perspectives and refine my own ideas.

3.2. Brainstorming Results

In my personal brainstorming process, I generated 32 ideas that ranged from simple revisions of the current interface to radical, impractical redesigns. I noticed seven major categories: small tweaks, new on-screen interfaces, voice-based control, physical control, gesture-based control, context-based switching, and current mode feedback.

My brainstorming process with generative AI generated 40 ideas with an even wider range of practicality and radicality. Interestingly, they included many of my ideas. ChatGPT organized the ideas into eight categories: touch-based interaction enhancements, voice and audio interaction, gesture and movement-based interaction, AI and smart features, user customization and control, innovative display and interaction methods, non-traditional interaction methods, and currently impractical concepts.

I decided to focus on on-screen operation, for which I had ten unique ideas for on-screen menus. I made a sketch of each and realized that seven would not address some of the users' main concerns from the needfinding results: comfort, speed, errors, and awareness. For example, a rotatable semicircle menu would, similar to the current interface, only display a few modes and still have issues with accuracy. Then, I chose to move three design alternatives to the prototype stages: a grid menu, a dropdown menu, and a circle menu.

The first design alternative is a grid menu. Users press a button that opens a menu that displays all seven camera modes in a grid of rectangles, circles, or some other format. Each mode has an icon and its name. Users then tap their desired mode. This layout enhances discoverability and speed by displaying all options and not requiring users to swipe through a sequence of modes. By using bigger icons and allowing users to explicitly tap their desired mode, it also improves comfort.

The second design alternative is a drop-down (or pop-up) menu. Users tap a button that brings up a drop-down menu of all camera modes stacked on top of each other. They are represented by an icon and name. This layout enhances discoverability by displaying all camera modes and perhaps direct manipulation with the tactile interactions. By allowing users to explicitly tap their de-

sired mode, it improves speed and reduces errors. Finally, drop-down menus are widespread, so the familiarity may improve usability for novice users.
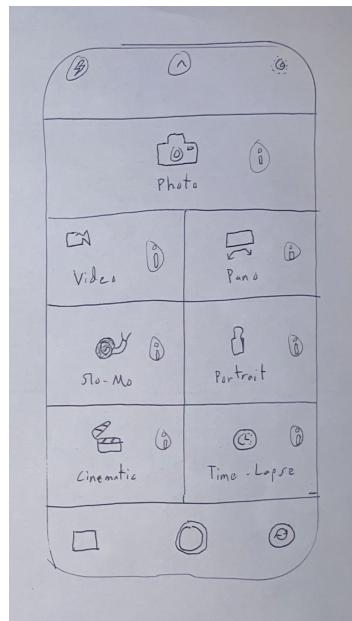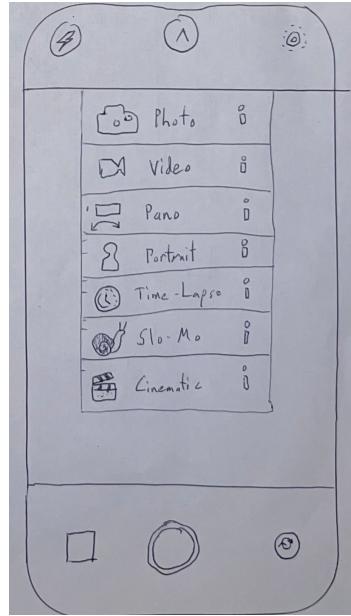
The third design alternative is a circular menu. Each mode is represented by an icon and name in a "slice" of the circle. Users tap modes or spin the wheel to change between camera modes, and the mode at the top is selected. Similar to the other two, this alternative enhances discoverability.

4. INITIAL PROTOTYPING

These are all screen-based interfaces, so I started with a paper prototype for each of the three design alternatives. These are easy to put together and revise, and they disguise superficial details like specific colors, icons, layouts, etc. They are also be easy to show to and test with users, who can hold the prototype in their hand and tap it like a phone.

I started by tracing my phone to match the size and other buttons on the iPhone camera screen (capture and flip camera button, flash, etc.) to retain all features and functionality of the current interface. I am primarily interested in the camera mode mechanism. I then sketched a few iterations of each design alternative to ensure that everything fit and was coherent.
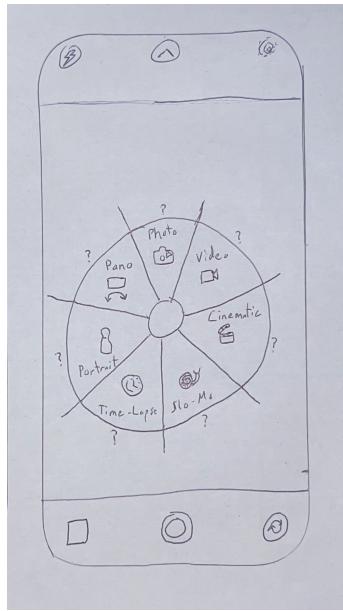
4.1. Grid Menu

Figure x shows the grid menu prototype. Users press a button to open the menu. The screen displays all modes and is split evenly to be consistent. One problem I ran into was that there are seven camera modes, so the screen cannot be divided evenly. I chose to give "Photo" more space and put it at the top because it is the most frequently used mode. I also sorted video-based modes on the left and photo-based modes on the right There is no more swiping: users tap to open the menu and tap their desired mode: a maximum of two taps (assuming no errors).

The buttons are big, which makes them more readable and easy to tap. Users may be more aware of what mode they are choosing, and the menu is more tolerant, which may reduce the error rate. However, this iteration uses the entire screen, which could cause reach/mobility issues for buttons at the top of the screen in one-handed use. Moreover, iOS currently only displays mode *names*. In all three prototypes, I added icons that represent each camera mode's functionality. These representations should make it easier for users to map the interface to reality.

4.2. Drop-down/Pop-up Menu

Figure x shows the drop-down (or pop-up) menu. Users press a button to open the menu, then select their desired camera mode. However, here, the camera modes are all stacked on top of each other. I placed "photo" at the top because it is the most used mode. It displays all modes, increasing discoverability. Moreover, drop-down and pop-up menus are widespread, so most users will have familiarity with how the menu works.

Similar to the previous prototype, the buttons here are more readable and easy to tap, and there is a maximum of two taps. The buttons are smaller than the grid menu, which may increase the required accuracy and effort of taps, but they are likely easier to reach in one-handed use, which may make it more comfortable in another aspect.

4.3. Wheel Menu

Figure x shows the wheel menu prototype. The circle displays all modes and is divided evenly to be consistent. Users tap a button to open the menu, then tap or spin the wheel to select the mode. The top mode is active and highlighted. The wheel may be an affordance (wheels spin) and could be an analogy to turning a camera lens to change the mode.

I again use icons as representations. By displaying all modes, this menu increase discoverability and possibly speed compared to the current interface. It may be more comfortable than the other two menus in one-handed use because no reaching is required. However, it may slow down users by requiring them to pass through modes in between.

In theory, users tap to open a menu and tap or spin to their desired mode: a maximum of two actions (assuming no errors). Having to cycle through other modes may increase the risk of errors with the inaccuracy involved in spinning an on-screen wheel and the possibility of accidentally tapping another mode.

5. EVALUATION

5.1. Evaluation Planning

Ideally, the interface will be discoverable and easy to learn for novices and maintain efficiency for experts. Thus, to evaluate my prototypes, I will recruit users with a range of experiences with the current interface, from non-iOS users to expert users. I am especially interested in non-iOS users to gauge the learnability of each prototype. I will recruit participants from my friends, family, and classmates with no incentives, as they have no personal stake in favor of any particular prototype.

I use online survey to establish a general sense of user perceptions and preferences about the three prototypes. Appendix 8.4 includes the specific questions. The first section collects basic demographic information to build a picture of the users. The second section asks participants to rate the three prototypes on three aspects that are important to users: clarity, ease of use, and visual appeal. In the third section, participants choose the prototype they find best for each aspect, then their favorite overall.

I will calculate descriptive statistics with the quantitative data from the surveys, then compare the prototypes using paired t-tests to see if there are significant differences in any of the aspects I measure. Given the small sample size, these tests will be more exploratory than conclusive. The quantitative data will indicate which prototype performs best in each aspect (though probably not conclusively here). Combined with the descriptive feedback from the live

demonstration, I will choose which design alternative to move forward and have some specific ideas of how to improve it.

I will then conduct a thematic analysis of the qualitative data from the survey, categorizing it into recurring themes. This process will highlight usability issues and preferences, providing specific insights on where users experience confusions or annoyances with the prototypes. It will also identify how they can be changed to closer match user needs and preferences.

5.2. Evaluation Results

There were 16 responses to my survey from a wide variety of users, representing almost every age group and level of experience. Appendix 8.5 shows the raw results. I recruited participants by emailing it to friends and family, and by posting it to the class forum. There were no users with visual or motor impairments, so the results may not be as insightful or generalizable for these groups.

Participants first rated each prototype based on the three aforementioned aspects (clarity, ease of use, and visual appeal). They had positive opinions of all three prototypes, but opinions varied for each aspect and menu. Table x shows the ratings by aspect for each of the three prototypes.

	Grid	Drop-Down	Wheel
Clarity	4.71	4.36	4.21
Ease of Use	4.64	3.93	3.36
Visual Appeal	3.71	3.50	3.86

I used a one-way ANOVA test to determine if there were significant differences in ratings for the prototypes across the three aspects. Appendix 8.6 shows the results. At an alpha of 0.05, the test only indicated a significant difference within ease of use ($p = 0.00067$). I then conducted three paired t-tests between the prototypes locate the difference(s).

The results indicated that participants rated the grid menu significantly higher than both the drop-down menu (p = 0.0454) and the wheel menu ($p = 0.00000654$). The difference between the drop-down menu and wheel

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menu was not quite statistically significant ($p = 0.0572$). Thus, we conclude that users find the grid menu easier to use compared to the other prototypes.

In the next section, participants compared the prototypes against each other and the current menu. There was a clear preference for the prototypes over the current menu overall and for each individual aspect:

- **Clarity**: The grid menu led with 56.3% of participants finding it the clearest. The drop-down menu followed with 37.5%, and the wheel was least preferred at 6.3%.

- **Ease of Use**: The grid menu also led in ease of use with 50.0% of participants finding it the easiest to use. Again, the drop-down menu was second at 43.8%, and the wheel was last at 6.3%.

- **Visual Appeal**: Preferences were more evenly distributed here. The grid menu led with 37.5% of participants finding it most appealing, followed by the wheel menu at 31.3%, the drop-down menu at 18.8%, and the current iPhone interface at 12.5%.

- **Overall Preference**: When asked to choose only one interface, participants were split between the grid and drop-down menus at 37.5% each, while 18.8% preferred the wheel menu, and 6.3% preferred the current menu.

Curiously, despite the grid menu leading the drop-down menu in every individual aspect, they tied overall, so there is not one obvious winner overall.

6. SECOND ITERATION

6.1. Second Iteration Planning
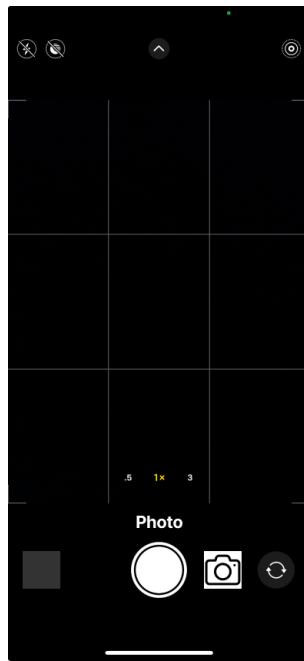
While the three prototypes showed improvements over the current iOS camera mode carousel, the grid menu seems to most effectively address the key user needs from my needfinding activities. Compared to the current interface, it is more readable, more comfortable, quicker to navigate, and increases awareness of the current camera mode. Despite tying with the drop-down/pop-up menu for the overall choice, the grid menu clearly won in each individual aspect, so I choose it for the second iteration.

However, the evaluation results indicate new areas of the grid menu that are problematic for users. Since the menu extends to the top of the screen and users can no longer swipe between modes, reachability was an issue—especially in one-handed use. While in practice, the severity of this issue will vary between specific users and phone models, I considered some ways to alleviate it.

Specifically, I noticed that "Photo" was the most difficult mode for participants to reach. I placed it at the top because, being the most commonly used mode, I wanted to make it the most discoverable. However, I did not consider the implications for reachability: it might be better on the bottom row, where it is the easiest mode to reach with the thumb and *still* the most noticeable mode.

6.2. Final Prototype

Based on the feedback from the first evaluation, I only advanced the grid menu to the second iteration. I created a high-fidelity, fully functional, interactive prototype. Figure X shows the initial screen that displays when the user opens the camera. Similar to the current interface, "Photo" is selected by default, as it is the most frequently used.
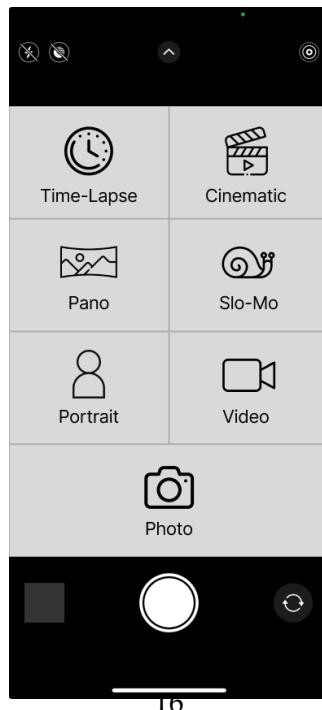

Notice the addition of the icon square in the bottom right corner. It displays the icon associated with the current camera mode. This representation provides

more intuitive and noticeable feedback about which mode is selected. I placed it in the bottom right corner to best accommodate thumb reachability in one-handed use. While the proximity to the capture and flip buttons may increase the risk of errors, the tap target is still larger than the current menu's mode buttons, and there is still ample space around it.

The menu replaces the current menu's mode carousel with a single piece of information: the current mode's name. Excluding extraneous information makes it easier for users to parse and interpret the feedback, which should increase awareness of the selected mode. I could then increase the font size, making the menu more readable and comfortable. These changes make the interface more perceptible by keeping users better informed about its current state.

Then, to open the grid menu, users press the icon square. I used a white square as the background to hopefully create a perceived affordance: that the element can be tapped. I also included the word "Modes" as a signifier to indicate what users should do to access the other modes.

Figure x shows the final prototype of the grid menu. The grid dimensions are almost the same as the paper prototype, but I flipped the layout and located the most used camera modes (photo, video, portrait) near the bottom. These modes will now be the easiest to reach and tap in one-handed use. While there might

still be some issues reaching modes near the top, they are the least used modes and generally require more involved and conscious use anyway.

Importantly, the camera mode names are now bigger and more readable than in the current interface, and the representations make it easier to quickly identify where each mode is. They give some idea of what each mode does, which may improve discoverability and accessibility for novices. They also make the interface more efficient for expert users, who can simply scan the icons.

While building the prototype, I also realized that the grid menu enables learned invisibility. Each modes has a dedicated spot on the screen, and over time, users will become familiar with its location. Eventually, instead of having to read the name of what mode is selected or locate its icon, they can simply open the menu and press the appropriate area of the screen.

To choose a mode, users simply tap the their desired mode's box. The boxes are much bigger than the tap targets in the current carousel menu, which makes them more comfortable, more tolerant to precision, and more accessible to users with motor and visual difficulties. Moreover, users explicitly choosing a mode rather than cycling through them makes them more conscious of their choice, which should decrease the risk of accidental mode selection/capturing.


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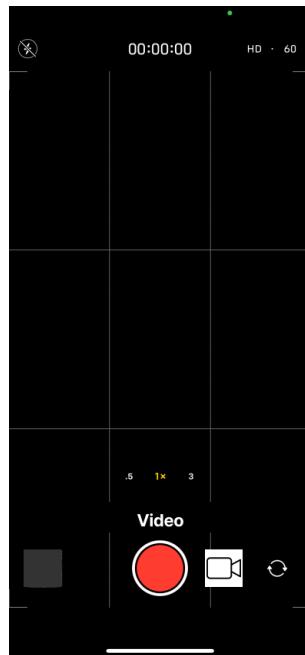
Figure x shows the result of a user tapping "Video". The menu works as users would probably expect: tapping a camera mode selects that mode and returns them to the capture screen. Notice that the menu icon and name updated to match the current mode. Moreover, I retained each mode's specific aesthetics (e.g., the "capture" circle and mode specific information) to maintain consistency and provide extra feedback about the current mode.

6.3. Final Evaluation Planning

To evaluate the final prototype, I will recruit users with a range of experience levels to better represent the population. I am primarily interested in iPhone users to compare their experience to the current interface but will include non-iOS users to measure learnability. Participants will be friends and family, again with no incentives, as they have no bias in favor of any prototype.

Participants will first complete a series of tasks that involves switching between camera modes in both the current *and* prototype menus to have a basis of comparison. I will counterbalance the order of the two interfaces to avoid sequence effects. The prototype is fully functional and can be used on a mobile device with the same dimensions as the current interface, allowing for a realistic comparison. I will load the prototype on my iPhone and have users complete the tasks on it.

After completing the instructions, users will have a chance to explore the interface independently and provide qualitative feedback on their likes, dislikes, confusions, suggestions, etc. Following the interaction, participants will complete a questionnaire (see Appendix 8.7) to assess their experience with the prototype. They will rate it on a handful of aspects including ease of use, intuitiveness, visual appeal, and overall, then compare it to the current interface.

To evaluate the quantitative questionnaire data, I will calculate descriptive statistics of the ratings to provide a general understanding of participant attitudes for each aspect, then conduct a binomial test to determine which, if any, menu participants prefer (though again, the sample size will likely be too small for any meaningful conclusions). Finally, I will analyze open-ended responses using thematic analysis and identify trends in opinion.

6.4. Final Evaluation Results

6 participants participated in my live demonstration. I recruited them from friends and family. There was not as wide of a range of experience as hoped. However, all interactions went smoothly, and all participants were able to understand how to use the prototype with no guidance.

Appendix 8.8 summarizes the results of the evaluation. Participants had positive opinions of the prototype menu, rating it better than the current iOS menu for efficiency and intuitiveness. However, they rated it lower for visual appeal. Table x shows each the mean ratings by aspect for both menus.

Variable	Current	Prototype
Efficiency	3	4.66
Intuitiveness	3.67	4.83
Visual Appeal	4.16	3.83

I conducted three t-tests to test the significance of the differences in ratings between the two menus for each aspect. Table x shows the results.

Variable	p-value
Efficiency	0.011
Intuitiveness	0.00092
Visual Appeal	0.73

In the next section, participants compared the prototype to the current menu. There was a clear preference for the prototypes over the current menu overall and for efficiency and intuitiveness:

- **Efficiency**: 100% of participants found the grid menu more efficient than the current iOS menu.

- **Intuitiveness**: Again, 100% of participants found the grid menu more intuitive than the current iOS menu.

- **Visual Appeal**: Preferences were split evenly here. Half of participants preferred the grid menu, and half preferred the current menu.

- **Overall Preference**: When asked to choose only one interface, 100% of participants chose the grid menu.

The quantitative data from the survey indicate a clear preference for the prototype over the current iOS menu. However, they indicate a major weakness: the prototype simply does not match user expectations for its visual appeal. Then, the next iteration may focus more on look and feel prototyping and evaluation.

I then coded the qualitative data into themes for thematic analysis. Five out of six users enjoy that it is faster because they do not have to tap through the other modes. For difficulties, three users expressed concerns with reachability, especially for modes at the top.

Finally, all five suggestions involved the visual appeal of the prototype. Four of these suggestions could be described as "making the menu match the overall camera interface." Again, then, the next iteration might involve look and feel prototypes to more closely align the menu with the iOS interface.

7. VIDEO PROTOTYPE

https://mediaspace.gatech.edu/media/t/1_y033hi1r

8. APPENDICES

8.1. Appendix 8.1: Raw Needfinding Observations

Observation 1:

A tourist couple sightseeing at a landmark. Partner asks to take a video. User accidentally taps "Pano" when switching, then is confused about the panorama screen and asks for help.

Insight: Tapping can lead to accidental overshooting, highlighting the need for clearer navigation.

Observation 2:

A person capturing the sunset from a rooftop. They start in photo mode, but struggles when trying to zoom, accidentally switching modes.

Insight: Accidental mode switching from swiping.

Observation 3:

A solo tourist at a historical monument. They are in portrait mode trying to zoom out, confused about why they can't.

Insight: Confusion about which mode they are in (perhaps accidentally switching to that mode) and understanding about their functionality.

Observation 4:

A person recording a video of street performers. They struggle to switch to video mode while framing the shot, accidentally using photo mode to record.

Insight: Confusion about which mode they are in, accidentally switching modes

Observation 5:

An older person taking a video of street performers. They want to record a video but forgot to press record. Someone else tells them they aren't recording. They say "Oh I didn't even notice" and click record.

Insight: Forgetting to press record when switching modes suggests a need for better feedback.

Observation 6:

A person recording street performers. They point the phone at the performers but have to lower and check the screen to check if the right mode is selected. After checking, they proceed to record.

Insight: Mode switching can slow down users and disrupt capturing real-time events, indicating a need for easier access.

Observation 7:

An older person taking a photo of a historical building. They take a video when they mean to take a picture. They tap once to take a picture (but start recording), then lower their phone while it is still recording.

Insight: Users may not notice the current camera mode, indicating a need for clearer indicators.

Observation 8:

A grandparent with their grandchild. Child asks them to record a Slo-Mo video of them. Grandparent opens the camera app but looks unsure while looking at the screen. They ask "How do I do that?"

Insight: Lack of familiarity with specific modes highlights the need for clearer guidance for less commonly used features.

8.2. Appendix 8.2: Needfinding Survey Questions

1. Select your age:

- Under 18

- 18-29

- 30-39

- 40-49

- 50-64

- 65+

How would you rate your experience level with using an iPhone?

- Novice (mostly use basic functions)

- Competent (familiar with common tasks, some searching still required)

- Proficient (comfortable with most features)

- Advanced (extensive experience, advanced functionalities?

2. Which ways do you commonly use to access the camera? (Select all that apply)

- The "Camera" app

- The camera icon on the lockscreen

- Swiping to the left on the lockscreen

- The camera icon in the control center

- Siri or Voice Control

- The action button (iPhone 15+)

- A third-party app

3. Which camera modes do you regularly use? (Select all that apply)

- Photo

- Video

- Portrait

- Pano

- Slo-mo

- Time-lapse

- Cinematic (iPhone 13+)

4. Are there any camera modes you have never used? (Select all that apply)

- Photo

- Video

- Portrait

- Pano

- Slo-mo

- Time-lapse

- Cinematic (and I have access to it)

- Cinematic (I do not have access to it)

- No, I've used them all

5. For modes you have never used, why? (Select all that apply)

- I didn't know they exist

- I don't what they do

- They are hard to access

- I find them unnecessary in general

- N/A, I have used all modes

- Other…

6. For modes you rarely use, why? (Select all that apply)

- I don't know what they do

- I don't know how to use them

- They don't fit my typical use case

- They are hard to access

- I find them unnecessary in general

- N/A, I regularly use all modes

- Other…

7. Are there any camera modes whose functionality you do not understand? (Select all that apply)

- Photo

- Video

- Portrait

- Pano

- Slo-mo

- Time-lapse

- Cinematic (and I have access to it)

- Cinematic (I do not have access to it)

- No, I understand them all

8. Primarily, how do you switch between camera modes?

- Tapping the names on the camera mode bar

- Swiping the screen left and right

9. How satisfied are you with the process of switching between camera modes in the current interface?

- Very satisfied

- Satisfied

- Neutral

- Unsatisfied

- Very unsatisfied

10. How easy or difficult do you find it to locate and select your desired camera mode?

- Very easy

- Easy

- Moderate

- Difficult

- Very difficult

11. How fast do you find it to switch to your desired camera mode?

- Very fast

- Fast

- Moderate

- Slow

- Very slow

12. How often do you accidentally switch the camera mode?

- Very frequently

- Frequently

- Occasionally

- Rarely

- Never

13. Have you ever accidentally captured media in the wrong mode?

- Yes

- No

- Not sure

14. Have you ever missed a photo/video opportunity due to difficulties selecting the right mode?

- Yes

- No

- Not sure

15. Do you ever feel overwhelmed by the number of camera mode options?

- Yes
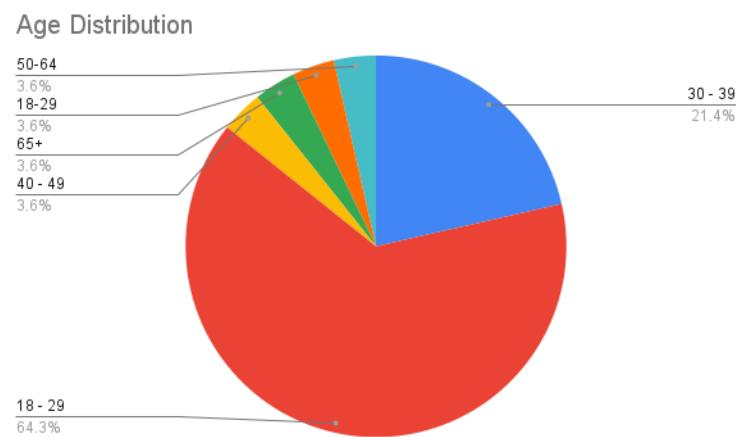
- No
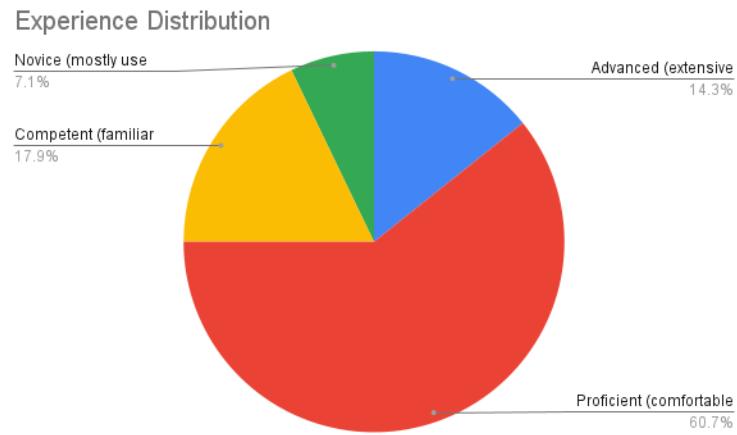
16. If you could change one aspect of the interface, what would it be (if any)?

- Faster mode switching

- Easier to locate and select the right mode

- More readable mode labels

- More feedback about which mode is selected

- Descriptions of each mode's functionality

- Customizability (e.g., ability to rearrange modes)

- Reduction of clutter

- Improved aesthetics, prettier interface

- Shortcuts to access specific modes

- I wouldn't change anything

- Other…

17. Is there anything else you'd like to share about your experience with the iOS camera interface or this survey?

8.3. Appendix 8.3: Needfinding Survey Results

Experience Distribution

Novice (mostly use
7.1%

Competent (familiar
17.9%

Advanced (extensive
14.3%

Proficient (comfortable
60.7%

Which ways do you commonly use to access the camera?

· **The "Camera" app:** 23 responses

· **The camera icon on the lock screen:** 20 responses

· **Swiping to the left on the lock screen:** 10 responses

· **The camera icon in the control center:** 7 responses

· **The action button (iPhone 15+):** 2 responses

· **Siri or Voice Control:** 2 responses

· **Third-party camera app:** 2 responses

Which camera modes do you regularly use?

· **Photo**: 28 responses

· **Video**: 26 responses

· **Portrait**: 18 responses

· **Pano**: 4 responses

· **Slo-mo**: 2 responses

· **Time-lapse**: 3 responses

· **Cinematic**: 1 response

Are there any camera modes you have never used?

- **No, I've used them all:** 6 responses

- **Photo**: 1 response

- **Video**: 1 response

- **Portrait**: 5 responses

- **Pano**: 7 responses

- **Slo-mo**: 8 responses

- **Time-lapse**: 12 responses

- **Cinematic (and I have access to it)**: 13 responses

- C**inematic (I do not have access to it)**: 5 responses

For modes you have never used, why?

- **I didn't know they exist:** 8 responses

- **I don't know what they do:** 9 responses

- **They are hard to access:** 0 responses

- **I find them unnecessary in general:** 15 responses

- **N/A, I have used all modes:** 7 responses
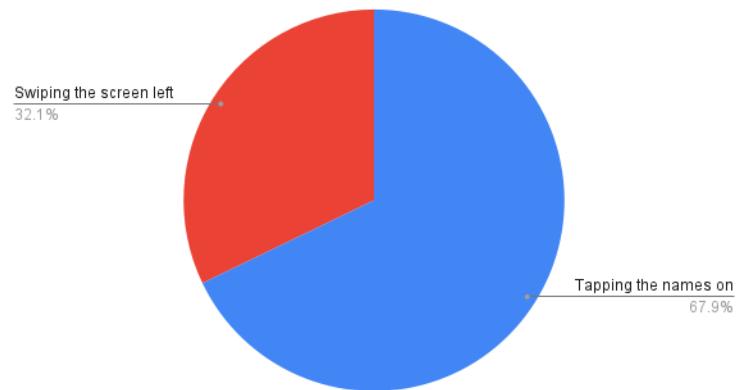
For modes you rarely use, why?

- **I don't know what they do:** 0 responses

- **I don't know how to use them:** 5 responses

- **They don't fit my typical use case:** 19 responses

- **They are hard to access:** 1 response

- **I find them unnecessary in general:** 11 responses

- **N/A, I regularly use all modes:** 2 responses
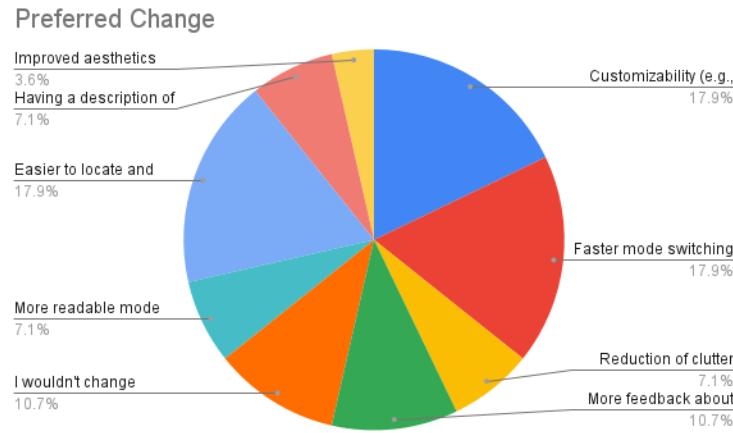
Are there any modes that you do not understand?

- **No, I understand them all:** 10 responses

- **Photo**: 0 responses

- **Video**: 0 responses

- **Portrait**: 2 responses

- **Pano**: 3 responses

- **Slo-mo**: 2 responses

- **Time-lapse**: 3 responses

- **Cinematic (and I have access to it)**: 11 responses

- C**inematic (I do not have access to it)**: 4 responses

Tap vs. Swipe

Swiping the screen left
32.1%

Tapping the names on
67.9%

Question	Rating (1-5)
Satisfaction with Mode Switching	3.64
Ease of Selecting Mode	3.71
Speed of Mode Switching	3.61
Frequency of Accidental Switching	3.04
Question	Percentage
Accidental Capture in Wrong Mode	85.2%
Missed Opportunities	77.8%

Preferred Change

8.4. Appendix 8.4: First Prototype Evaluation Survey Questions

Section 1: Demographics

1. Select your age:

- Under 18

- 18-29

- 30-39

- 40-49

- 50-64

- 65+

2. How would you rate your experience level with using an iPhone?

- None: I have almost never used an iPhone

- Novice (mostly use basic functions)

- Competent (familiar with common tasks, some searching still required)

- Proficient (comfortable with most features)

- Advanced (extensive experience, advanced functionalities)

3. Do you have any visual/motor impairments?

31

- Yes

- No

- Prefer not to answer

Section 2: Prototype Ratings

Prototype 1: Grid Menu

4. How clear/understandable is the layout of this prototype?

- 1 (Very unclear) to 5 (Very clear)

5. How easy do you think it would be to navigate this layout?

- 1 (Very difficult) to 5 (Very easy)

6. How visually appealing is this layout?

- 1 (Not appealing at all) to 5 (Very appealing)

7. Would you prefer "Photo" in the top or bottom row?

- Top

- Bottom

8. Do you have any other feedback or suggestions for this prototype?

Prototype 2: Drop-Down Menu

9. How clear/understandable is the layout of this prototype?

- 1 (Very unclear) to 5 (Very clear)

10. How easy do you think it would be to navigate this layout?

1 (Very difficult) to 5 (Very easy)

11. How visually appealing is this layout?

- 1 (Not appealing at all) to 5 (Very appealing)

Do you prefer prototype 2a or 2b?

- Prototype 2a (Drop-Down)

- Prototype 2b (Pop-Up)

12. Do you have any other feedback or suggestions for this prototype?

Prototype 3: Wheel Menu (imagine the top slice is highlighted). You can tap or spin the wheel.

13. How clear/understandable is the layout of this prototype?

- 1 (Very unclear) to 5 (Very clear)

14. How easy do you think it would be to navigate this layout?

- 1 (Very difficult) to 5 (Very easy)

15. How visually appealing is this layout?

- 1 (Not appealing at all) to 5 (Very appealing)

16. How would you prefer to navigate this menu?

- Tap

- Spin

- Both

17. Do you have any other feedback or suggestions for this prototype?

Section 3: Prototype Comparison

18. Which menu do you find clearest/easiest to understand?

- Prototype 1: Grid Menu

- Prototype 2: Drop-Down/Pop-Up Menu

- Prototype 3: Wheel Menu

- Current camera mode menu

19. Which interface do you find easiest to use?

- Prototype 1: Grid Menu

- Prototype 2: Drop-Down/Pop-Up Menu

- Prototype 3: Wheel Menu

- Current camera mode menu

20. Which interface do you find most visually appealing?

- Prototype 1: Grid Menu

- Prototype 2: Drop-Down/Pop-Up Menu

- Prototype 3: Wheel Menu

- Current camera mode menu

21. If you could only choose one interface, which would it be?
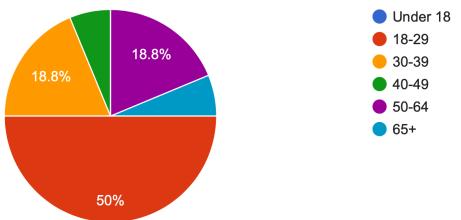
- Prototype 1: Grid Menu

- Prototype 2: Drop-Down/Pop-Up Menu

- Prototype 3: Wheel Menu

- Current camera mode menu

22. Do you have any final thoughts?

8.5. Appendix 8.5: First Prototype Evaluation Survey Results
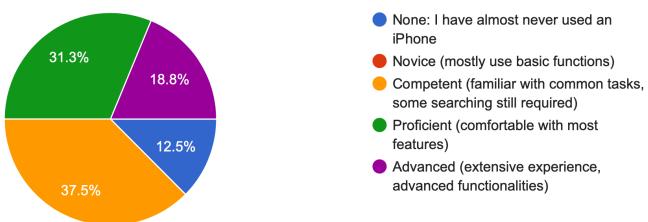
Select your age:
16 responses

- Under 18
- 18-29
- 30-39
- 40-49
- 50-64
- 65+

18.8%
18.8%
50%
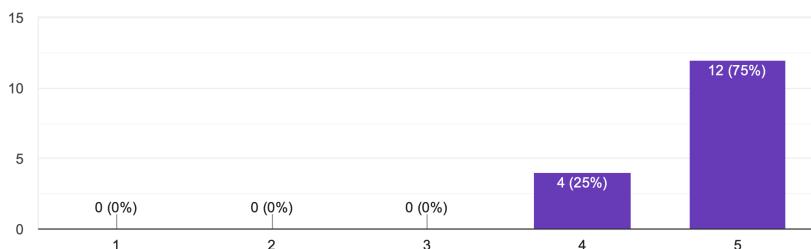
How would you rate your experience level with using an iPhone?
16 responses
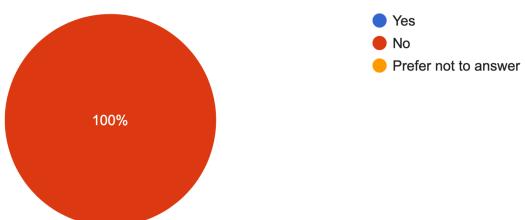
- None: I have almost never used an iPhone
- Novice (mostly use basic functions)
- Competent (familiar with common tasks, some searching still required)
- Proficient (comfortable with most features)
- Advanced (extensive experience, advanced functionalities)

31.3%
18.8%
12.5%
37.5%

How clear/understandable is the layout of this prototype?
16 responses

	0 (0%)	0 (0%)	0 (0%)	4 (25%)	12 (75%)
	1	2	3	4	5

Do you have any visual/motor impairments?
16 responses
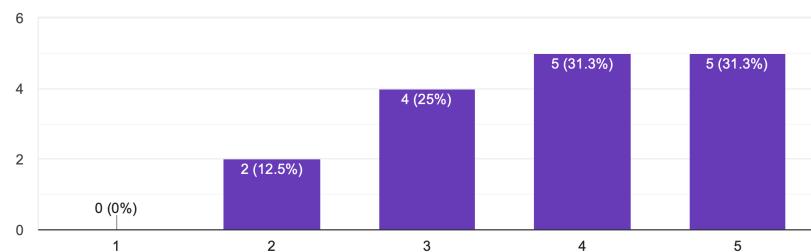
- Yes
- No
- Prefer not to answer

100%

How easy do you think it would be to navigate this layout?

16 responses

How visually appealing is this layout?

16 responses

Would you prefer "Photo" in the top or bottom row?

16 responses
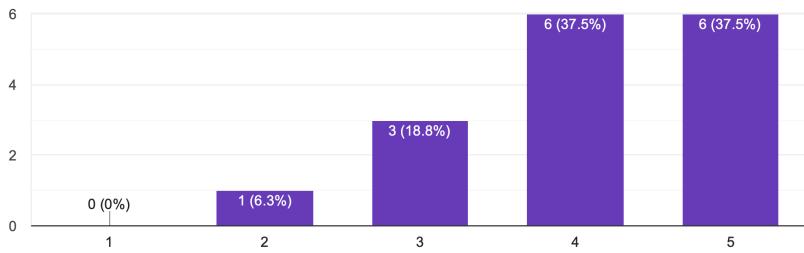
How clear/understandable is the layout of this prototype?
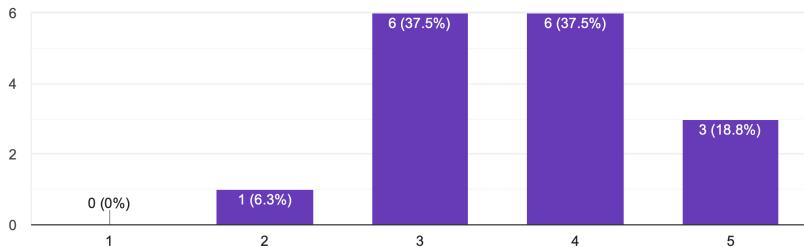
16 responses

How easy do you think it would be to navigate this layout?
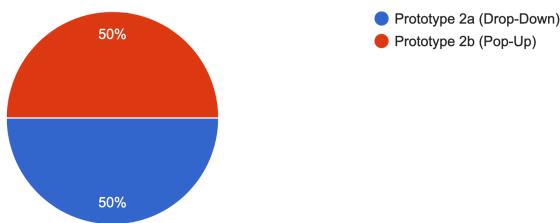
16 responses


How visually appealing is this layout?
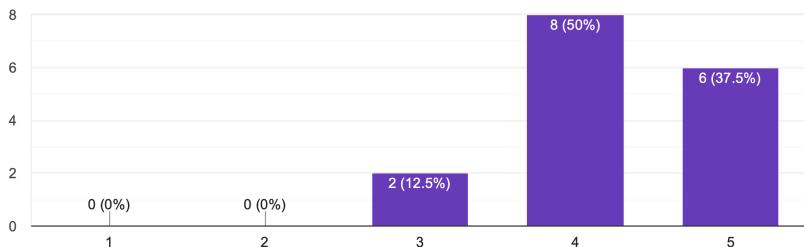
16 responses

Do you prefer prototype 2a or 2b?

16 responses

- Prototype 2a (Drop-Down)
- Prototype 2b (Pop-Up)

How clear/understandable is the layout of this prototype?

16 responses

37

How easy do you think it would be to navigate this layout?
16 responses
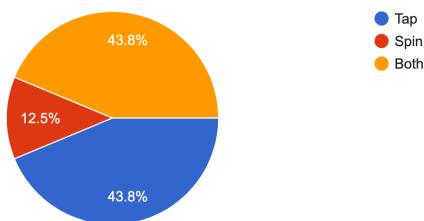
How visually appealing is this layout?
16 responses
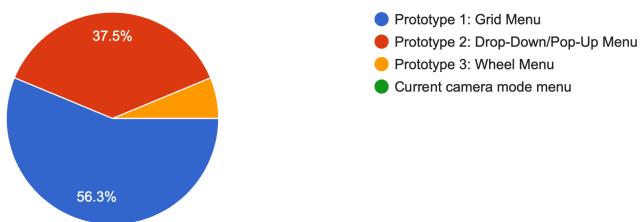

How would you prefer to navigate this menu?
16 responses

- Tap
- Spin
- Both
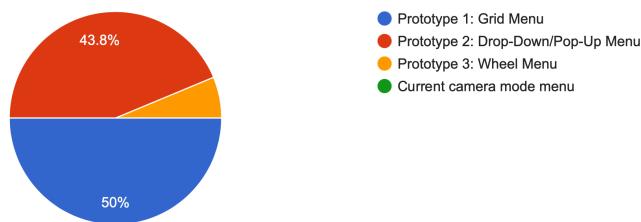
Which menu do you find clearest/easiest to understand?
16 responses

- Prototype 1: Grid Menu
- Prototype 2: Drop-Down/Pop-Up Menu
- Prototype 3: Wheel Menu
- Current camera mode menu
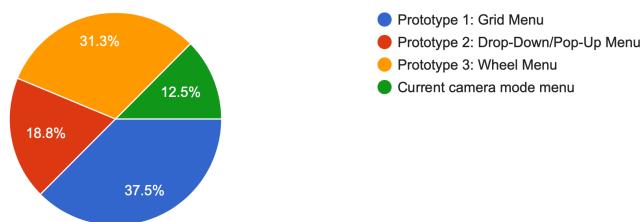
Which interface do you find easiest to use?

16 responses

- Prototype 1: Grid Menu
- Prototype 2: Drop-Down/Pop-Up Menu
- Prototype 3: Wheel Menu
- Current camera mode menu
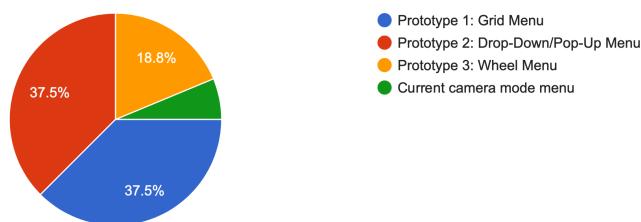
Which interface do you find most visually appealing?

16 responses

- Prototype 1: Grid Menu
- Prototype 2: Drop-Down/Pop-Up Menu
- Prototype 3: Wheel Menu
- Current camera mode menu

If you could only choose one interface, which would it be?

16 responses

- Prototype 1: Grid Menu
- Prototype 2: Drop-Down/Pop-Up Menu
- Prototype 3: Wheel Menu
- Current camera mode menu

8.6. Appendix 8.6: First Prototype Evaluation Survey Results Analysis

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.18	2	1.09	2.18	0.13	3.22
Within Groups	20.9	42	0.50			
Total	23.1	44				

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	12.04	2	6.02	8.74	0.00067	3.22
Within Groups	28.93	42	0.69			
Total	40.98	44				

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.53	2	0.27	0.31	0.74	3.22
Within Groups	36.27	42	0.86			
Total	36.8	44				

Pair	P-value
Grid vs. Drop-down	0.045*
Grid vs. Wheel	0.0000065***
Drop-down vs. Wheel	0.057

8.7. Appendix 8.7: Final Prototype Evaluation Survey Questions

Section 1: Demographics

1. How would you rate your experience level with using an iPhone?

· Almost none: I have rarely used an iPhone

· Novice (mostly use basic functions)

· Competent (familiar with common tasks, some searching still required)

· Proficient (comfortable with most features)

· Advanced (extensive experience, advanced functionalities)

Section 2: Current and Prototype Menu Ratings

2. How efficient do you find the current iOS menu for switching camera modes (how quickly and easily you can switch modes with minimal effort)?

· 1 (Very inefficient) to 5 (Very efficient)

3. How intuitive do you find the current iOS menu (how naturally/immediately understandable the interface is)?

· 1 (Very unintuitive) to 5 (Very intuitive)

4. How visually appealing do you find the current iOS menu?

· 1 (Very unappealing) to 5 (Very appealing)

5. How efficient do you find the prototype menu for switching camera modes (how quickly and easily you can switch modes with minimal effort)?

· 1 (Very inefficient) to 5 (Very efficient)

6. How intuitive do you find the prototype menu (how naturally/immediately understandable the interface is)?

· 1 (Very unintuitive) to 5 (Very intuitive)

7. How visually appealing do you find the prototype menu?

· 1 (Very unappealing) to 5 (Very appealing)

Section 3: Comparison with Current iOS Interface

8. Which menu do you find more efficient for switching camera modes?

· Prototype

· Current iOS Camera

9. Which menu do you find more visually appealing?

· Prototype

· Current iOS Camera

10. Which menu do you find more intuitive (naturally/immediately understandable)?

· Prototype

· Current iOS Camera

11. Overall, which menu do you prefer?
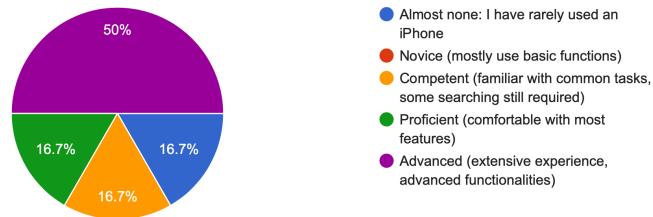
- Prototype

- Current iOS Camera

### *Section 4: Qualitative Feedback*
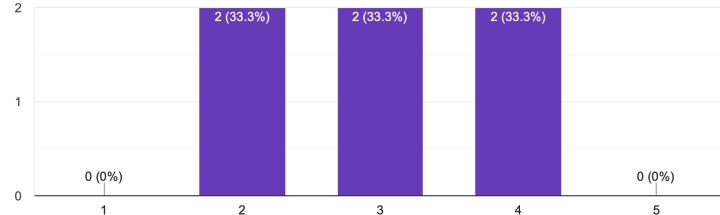
12. What, if anything, did you like about this camera mode selection menu?

13. What, if anything, did you find difficult or confusing about the menu?

14. Are there any changes you would make to the menu?

### Appendix 8.8: Final Prototype Evaluation Survey Results

How would you rate your experience level with using an iPhone?
6 responses
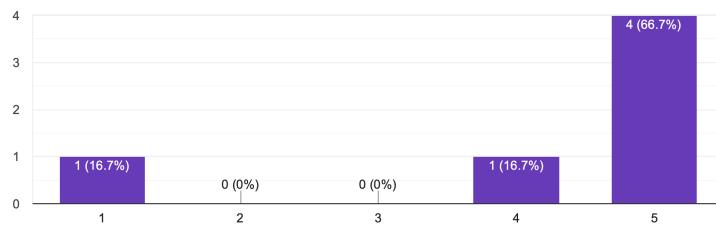
- Almost none: I have rarely used an iPhone
- Novice (mostly use basic functions)
- Competent (familiar with common tasks, some searching still required)
- Proficient (comfortable with most features)
- Advanced (extensive experience, advanced functionalities)

How efficient do you find the current iOS menu for switching camera modes (how quickly and easily you can switch modes with minimal effort)?
6 responses

How visually appealing do you find the current iOS menu?
6 responses
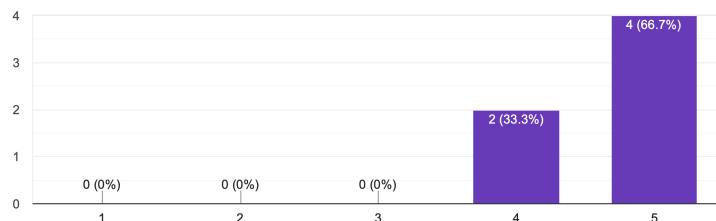
How intuitive do you find the current iOS menu (how naturally/immediately understandable the interface is)?
6 responses
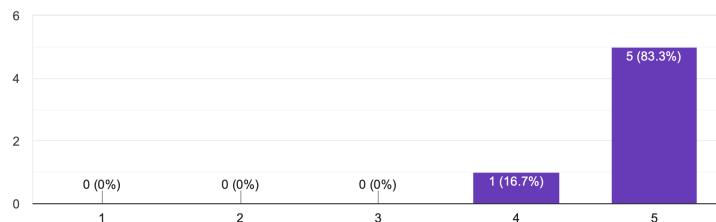
How efficient do you find the prototype menu for switching camera modes (how quickly and easily you can switch modes with minimal effort)?
6 responses
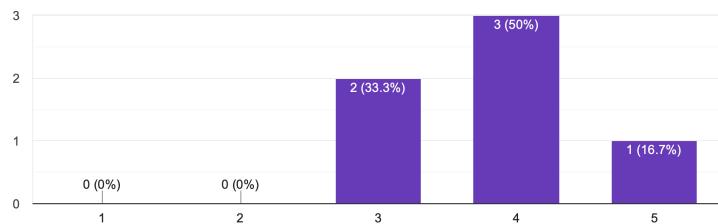
How intuitive do you find the prototype menu (how naturally/immediately understandable the interface is)?
6 responses
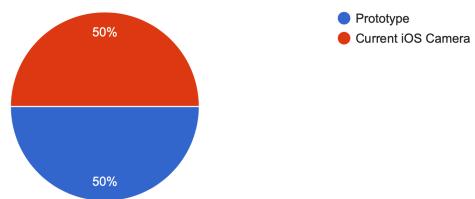
How visually appealing do you find the prototype menu?
6 responses
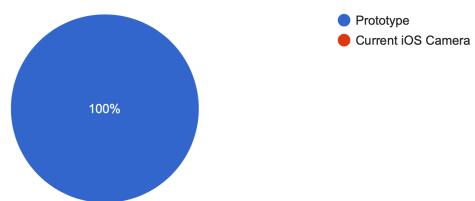
Which menu do you find more efficient (quick/easy to switch modes with minimal effort) for switching camera modes?
6 responses

- Prototype
- Current iOS Camera
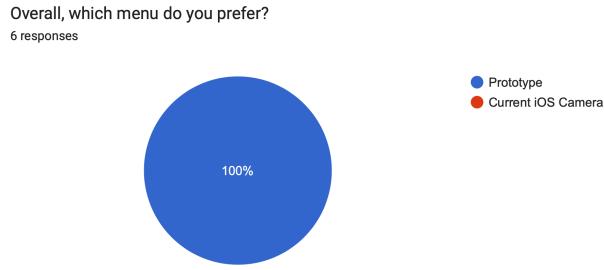
Which menu do you find more visually appealing?
6 responses

- Prototype
- Current iOS Camera

Which menu do you find more intuitive (naturally/immediately understandable)?
6 responses

- Prototype
- Current iOS Camera

Overall, which menu do you prefer?
6 responses

- Prototype
- Current iOS Camera

100%

What, if anything, did you like about this camera mode selection menu?

- Very easy to use, don't have to scroll through each mode to select one

- That it's much quicker than scrolling through the options.

- Buttons are bigger and easier to press. I don't have to tap through all the other modes.

- You can change camera modes with one click

- The buttons are a lot bigger and easier to press

- It is easier and faster to pick modes. I do not have to go through the others

What, if anything, did you find difficult or confusing about the menu?

- Hard to reach the modes on the top with just one hand

- You might have to use both hands or stretch your thumb a lot to pick the top options in the menu

- Not sure

- Reaching the top

Are there any changes you would make to the menu?

- Instead of white box with black outlined figure, could be a figure with no background

- If you could make the options transparent while the camera was on that would be cool and make it look more visually appealing.

45

- Maybe make the camera menu/icons transparent so you can see what's on the camera

- change the color scheme to match the app and make the icons smaller so you can pick the top options without stretching your thumb

- Maybe make the icons a bit nicer

- It's a bit ugly. Maybe you can make it look nicer like the regular menu