ONE BUS AWAY

DESIGN 1 - FINAL PROJECT

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Studio 2:00pm

I. Data Collection

Background

As soon as we formed into a group, we brainstormed a plethora of products that we could potentially use and also redesign for this project. The goal was to just come up with as many products as possible. Some ideas that popped up included toothpaste bottles, nail clippers, One Bus Away, and WebReg. Initially, our group settled on WebReg; we thought that having to open up multiple tabs to choose classes was extremely frustrating. Furthermore, the list and calendar view was misleading. When someone hovered over a class, the background color would turn lighter, making users think that it was a hyperlink and that they would be able to click on the class. Yet, once the user tried to click on it, nothing would happen. When we presented this idea in studio session, the IAs told us to possibly reconsider using WebReg because coming up with a design space would be difficult. As such, our group decided to change topics and choose the mobile app One Bus Away.

It should be noted that the One Bus Away app that we are working with is the older version. Agency X and Agency Y are beta versions available in the App Store that are currently being tested to rebrand One Bus Away. Because the older version is fully developed in comparison to the two beta versions, we decided that it would be better to focus on that one.

Interview Methodology

We chose One Bus Away because it was heavily advertised by MTS (*Figure 1*). Furthermore, all but one person in our group were first time users and could not initially figure out how to navigate through the app. After taking some time to really play around the app to fully understand its functions, we realized that a good feature to focus on for interviews is the search feature. This would include the search bar and finding the right bus to take.

Figure 1: MTS Advertisement of OneBusAway

Because we were a group of 6 people, we had the opportunity to interview a wide range of people all over campus. Our group ended up conducting interviews in pairs with 18 participants and went to locations such as Price Center, Geisel Library, and study lounges. One person would lead the interview and ask questions, while the second person would observe the participant and jot down notes. To keep all interviews consistent, we used the iOS version of One Bus Away, as the Android version has a slightly different user interface. Our interview was divided into three parts: pre-activity questions, activity, and post-activity questions. We tailored the interview to each participant and asked the questions in a slightly different order; we tried to build off of what participants said in their previous answer.

We knew that the way we worded questions would have a direct impact on how the participants would answer, so we made sure to ask open-ended questions. We also tried to write questions without imposing our own biases into it. The pre-activity questions let us gauge what kind of transit apps participants use regularly and whether or not they have any experience with the app.

Pre-Activity Questions

1. What transit apps do you use?
    a. If you do not use any, why?
2. What transit apps do you use?
3. When was the last time you used a transit app?
    a. What was it and for what purpose?
4. Have you used the One Bus Away app before?
    a. If yes, Android or iOS version?

After asking the pre-activity questions, we informed the participants that we wanted to conduct an activity to observe how they interacted with the app. We followed the master apprentice model, and treated the participants as if they were knowledgeable and experts on the One Bus Away app to make them feel more in control. This way, we would also be able to fully observe how they naturally interact with the app. The goal of the

activity is to see whether or not users could perform simple tasks related to the search feature that would be used on a daily basis. Tasks included finding the quickest bus route to a certain location, as well as when the next bus would come to a certain bus stop. We also purposely asked participants to change the app service region to Washington D.C. to test the interviewees who were already familiar with the San Diego bus system, or interviewees who were already familiar with the app. If participants could not solve a certain task, we told them to move onto the next one. Throughout the activity, we noted which steps the participants struggled with so that we could revisit it in the post-activity questions. We also screen recorded participants doing the activity to better analyze their interactions with the app.

Activity

Assume the closest stop is Gilman Transit Center

1. Find the quickest way to Westfield UTC
2. When is the next 201 bus coming to the Gilman Transit Center stop?
3. Find a bus that gets you from campus to La Jolla Shores
    a. How many minutes away is that bus?
    b. Count the number of stops to La Jolla Shores
4. Change region to Washington D.C.
    a. You are at the White House. Find the quickest way to Washington Union Station.

After participants completed the activity, we asked them the post-activity questions to see what they thought of the app and whether or not they would use it again. Furthermore, we brought up the steps we noted that the participants had a hard time with and asked them to go through their thought process during that step. This allowed us to better understand their mental model. We asked participants to rate the app after the entire interview, rather than right after the activity, because wanted participants to give free-flowing answers to the other questions. If we had asked them to rate before the other questions, they might have calibrated their response according to their numeric rating.

Post-Activity Questions

1. How was your experience with One Bus Away?
2. We noticed you had troubles with step --. Could you describe what was going on in your mind or why you think you made those errors?
3. After this experience, would you use One Bus Away? Why or why not?
4. Compare One Bus Away with the apps you frequently use.
5. Rate the app from 1-4

Interview spreadsheet

Screen recordings

II. Problems & Trends

From analyzing the data we collected, we found major problems and trends. Currently, when users click on the search bar, the phrase *"Type in an address, route number, or stop number here to search"* pops up (*Figure 2*). It is important to note that the designer's conceptual model of "route" refers to the bus number (e.g. 30, 150, 201), while "address" refers to the starting location. As such, users of the app are expected to find bus routes by only entering a bus number, starting location, or stop number. This is different from the user's mental model, as we found in step 1 that 18/18 participants initially typed in the destination (Westfield UTC) into the search bar (*Figure 3*). This would be classified as a knowledge-based mistake because participants had performed the action they intended to do, but with the wrong mental model. Because of the gap between the designer's conceptual model and the user's mental model, participants were unable to correctly use the search bar due to knowledge deficits. Furthermore, the search bar problem could also be classified as a capture slip. Typically, a search bar in widely used transit apps such as Google Maps or Apple Maps affords a user to type in a destination and have it return with a result. Instead of doing the desired action of typing in an "address, route, or stop number," users performed a more recent and frequent action, which is typing in a destination.

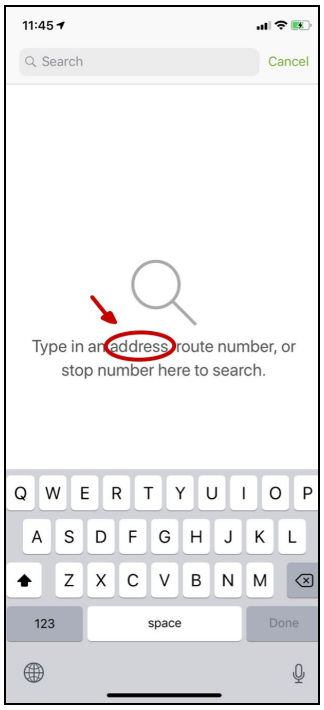


Figure 2: Instructions for search bar

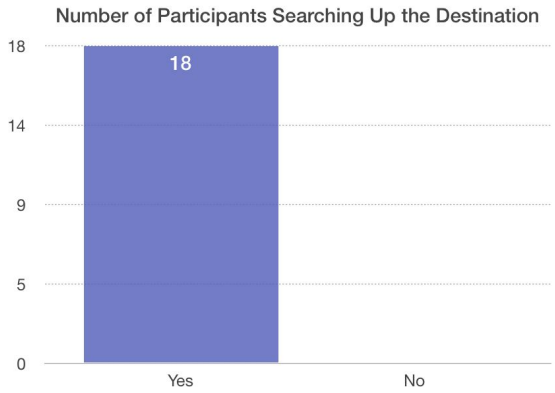


Figure 3: Graph of # of Participants Searching up Destinations

Once users typed in Westfield UTC (the destination) in the search bar, 5/18 participants tapped "route," while 13/18 tapped "address" (*Figure 4*). The participants who had tapped "route" or "address" both thought that they would see bus routes from their current

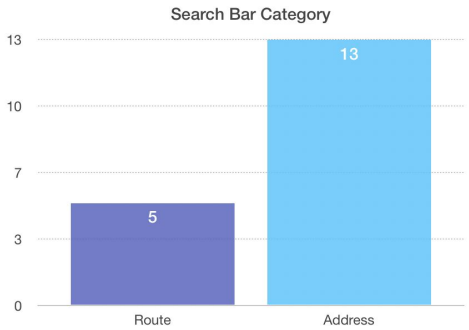


Figure 4: Graph of Search Categories Used

location to the destination that they had typed in. However, the ones who had selected "route" got a pop up message saying "No stops at this location" (*Figure 5*) because the app was expecting the user to enter in a bus number, not a word. It is misleading to say "No stops at this location" since after seeing that message, 1/5 participants who had tapped "route" just typed in a different variation of Westfield UTC (e.g. University Town Center), 2/5 went back and tapped "address," while the remaining 2/5 just gave up on the task. From this, it is evident that all 5 participants did not understand that they are actually supposed to enter in a bus number. This suggests a large gulf of evaluation because the message does not explain to these users what caused their mistake and why their action was incorrect. Instead, the designer should have used a message saying "Error: Please type in a bus number."

Figure 5: Tapping on "Route"

Figure 6: Tapping on "Address"

Meanwhile, the 13/18 interviewees who clicked on "address"after typing in Westfield UTC were directed to it on the map (*Figure 6*). Of these 13 participants, 10

noticed that their mental model of typing in a destination was wrong because the bus routes that showed up all started from Westfield UTC, which was supposed to be the destination. As such, these 10 participants typed in Gilman Transit Center instead and were able to find all possible bus routes from Gilman to Westfield UTC.

A trend that we found in step 1 was those 10 participants were unable to identify the most efficient route to take. The app tells users when the nearest bus will arrive at the bus stop, but does not immediately tell users when the bus will stop at the destination. For example, just because the 101 bus comes 2 minutes before the 202 bus does not mean that it would get to Westfield UTC faster. The only way for participants to figure out which bus would arrive to the destination first would be to manually tap into each bus and scroll to see when each bus would arrive at the Westfield UTC bus stop. When we asked participants to find the quickest way to Westfield UTC, all 10 participants just selected the bus that arrived at the Gilman Transit Center first.

As explained in the interview methodology, the purpose of including step 4, finding a bus route from the White House to Washington Union Station in D.C., was to test the search bar effectiveness in a foreign area. This way, users who were already familiar with the San Diego area would not be able to use any pre-existing knowledge to find bus routes. Right away, a problem we detected was that 18/18 participants were initially unable to change the location from San Diego to Washington D.C (*Figure 7*). The participants' instinct of zooming out of San Diego (*Figure 9*) on the map to find D.C. or typing in "Washington Union Station" suggests that a large gulf of execution exists. This is the case because zooming out of the map or typing the location in the search bar is not the correct way of changing locations on the app. In fact, the correct way to change locations would be to go into settings and manually change the service region to

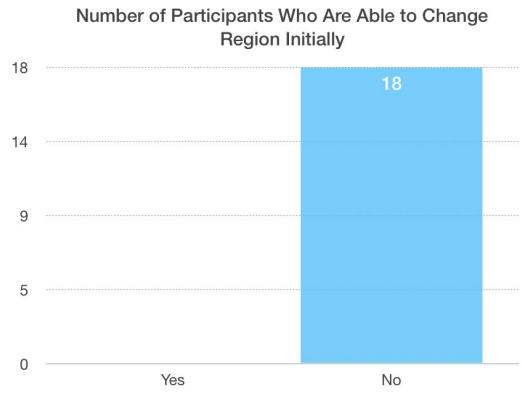


Figure 7: Attempt 1 at Changing Regions

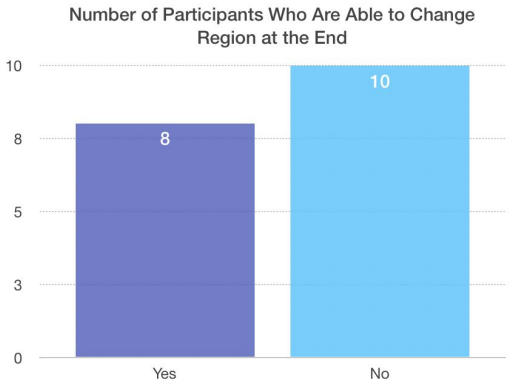


Figure 8: Final Attempts at Changing Regions

Washington D.C. 10/18 participants never figured out how to do this and just gave up on the task (*Figure 8*).

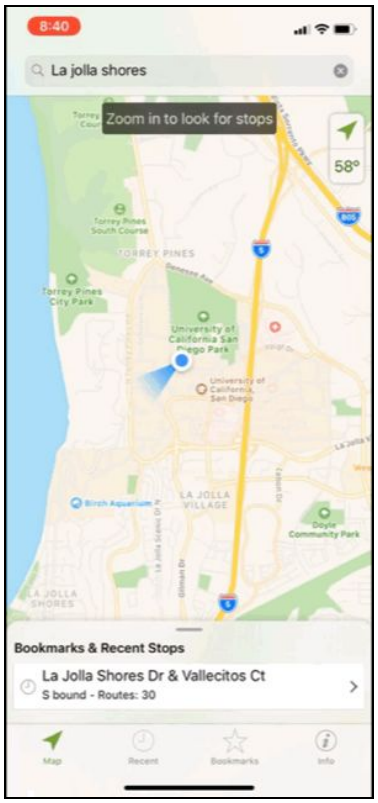


Figure 9: Zooming Out of San Diego

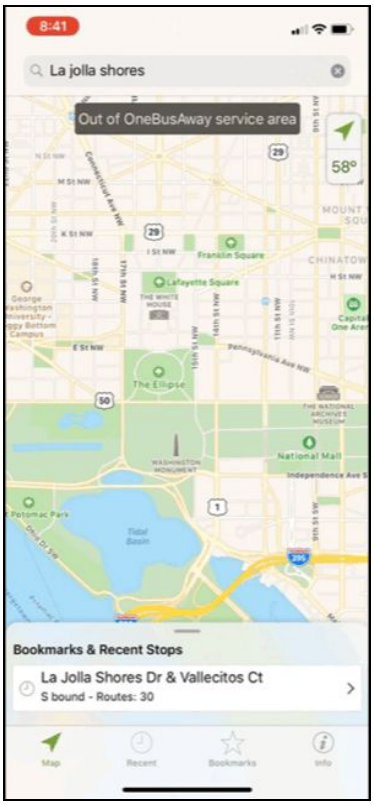


Figure 10: Correct Way to Change Regions

Ultimately, this means that the app does not effectively convey how to correctly change regions, which suggests that the gulf of execution is not bridged. The user's intentions of how to use this feature does not match up with how the app is supposed to be used. After the map was out of the San Diego area, a note that said "*You are out of the San Diego service area. Go there now? Cancel or OK*" (*Figure 9*) would pop up. Participants would click cancel and find their way into Washington D.C on the map. However, once in D.C., the top of the screen would say "*Out of OneBusAway service area*" and no bus stops would show up on the screen (*Figure 10*). This suggests a large gulf of evaluation because the app does not explain to the users what caused the mistake and why their actions were incorrect. The designers attempted to bridge the gulf of evaluation through the message "*Out of OneBusAway service area,*" but users could not evaluate

their actions and identify where the mistake took place. This causes users to repeat the same action, hoping for a different result because they have not understood why the action was incorrect.

This problem would be classified as a knowledge-based mistake because participants were not aware that they could not zoom out of the map to go to a new location. Furthermore, there was no effective signifier to inform participants that they would need to go into the settings to change regions. Again, it is evident that the designer's conceptual model and user's mental model were different. Because the app only works in certain cities, the designer felt that it would be more productive to have users manually select the locations in the settings. However, users are unaware of this, so if they were to go to a different city and try use the app, they would just zoom out of the map. This is because most map interfaces allow users to zoom out and go to a different region. As such, it is evident that the system image was unclear and thus not effective in communicating the designer's conceptual model to the user's mental model. Little efforts are made to bridge the gulfs of execution and evaluation to ensure that users understand how to use the app.

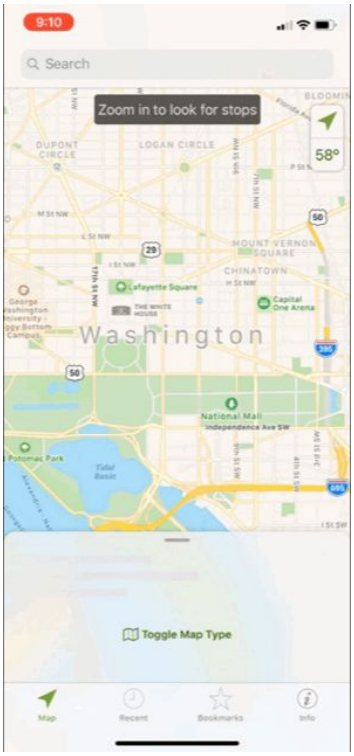


Figure 11: Typing in the Destination

After clicking around and trying any icon or button in the app, 8/18 participants eventually figured out how to change regions. The 8 participants initially performed the knowledge-based mistake described earlier but continued to try almost every possible button within the app to change regions because they did not want to give up. They literally clicked on the bottom icons until an option to select locations within the settings icon presented itself. Once they were finally in the new region, all 8 participants typed in the destination (Washington Union Station) and tapped "address" (*Figure 11*); again, this is an incorrect mental model because they typed in a destination, rather than a starting location. This would be considered a memory lapse slip for 3 of the participants because they learned in step 1 that in order to find a bus from a starting location to any destination, the users would need to search up the starting bus stop instead of the destination in the search bar. As such, when entering the destination did not help them with completing the task, these 3 participants typed in the starting location (White House) in the search bar. However, performing this action still did not allow them to easily find the bus route between the two locations, because efficient route options from the starting location to the intended destination are not shown. Since the search bar only accepts a very specific input of either a bus number, a bus stop, or an address, the participants had trouble finding bus stops around the White House or Washington Union Station. The bus stops were named after the two intersecting street names, so the participants were unable to locate these stops from the search bar. The only information shown is the next incoming buses from the starting location, and it is a hassle to go through every bus route to find which one leads to the destination.

Ultimately, because all 8 participants who were able to change to a foreign region could not figure out how to find a bus route between the White House and Washington Union Station, we can conclude that the search features of the app are poorly designed. This is because the app is targeted mainly for those who are already familiar with bus routes in a certain geographic location. By removing the factor of familiarity through changing regions to Washington D.C, we can identify that users without any knowledge of bus routes in a certain area would not find the app to be useful. The app's main feature, a

comprehensive list of incoming buses at each bus stop, is inefficient in terms of searching up a route from a specific starting location to a desired destination.

Furthermore, a trend that we noticed was that 13/18 participants mentioned in their interview that they thought the app looked extremely cluttered. This is because the home screen of the map has an icon for every bus stop in the surrounding area *(See Figure 14).* Lastly, when we asked participants if they had used the One Bus Away app before the activity, 14/18 said that they had not (*Figure 12*). After the activity, we asked participants whether or not they would use One Bus Away again, and found that 14/18 interviewees said they would not use the app after their experience (*Figure 13*). It is interesting to note that the 4 people who said that they had used the app before were the same 4 people who said they would still use the app after the interview. This goes to show how the app is difficult and frustrating to use for first time users. As such, our redesign will focus on tackling these core issues that we discovered through observing participants using the app.

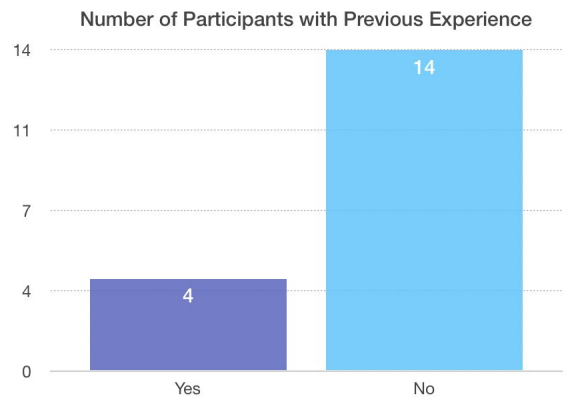


Figure 12: Distribution of first-time users

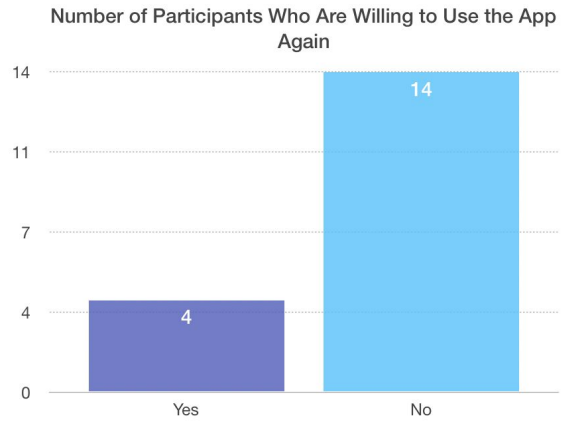


Figure 13: Distribution of possible recurring users

III. Prototype & Redesign

Discover & Define

Through our interviews, we identified many problems that we wished to fix. The affordance of changing regions lacked signifiers to inform users how to complete the task. Many users noted that the app was very cluttered and disorganized, which prevented them from identifying the information they needed as quickly as they would have liked. The main issue, however, was that the search bar was not intuitive. A more flexible search bar is required to address the user's mental model and accommodate for the user's inputs. Currently, the app's search bar is poorly designed, and our participants' inability to accomplish tasks efficiently or at all proves that the designer's conceptual model is quite different the user's mental model.

Given these issues, we wanted to bridge the designer's conceptual model and the user's mental model through our redesign. Our hope is to allow users to find efficient routes in less time even without prior knowledge of any bus routes in any given region. This is the main purpose of the app, but judging from our interviews, the current search bar impedes users from finding efficient bus routes. Thus, we decided upon redesigning the search bar.

Develop

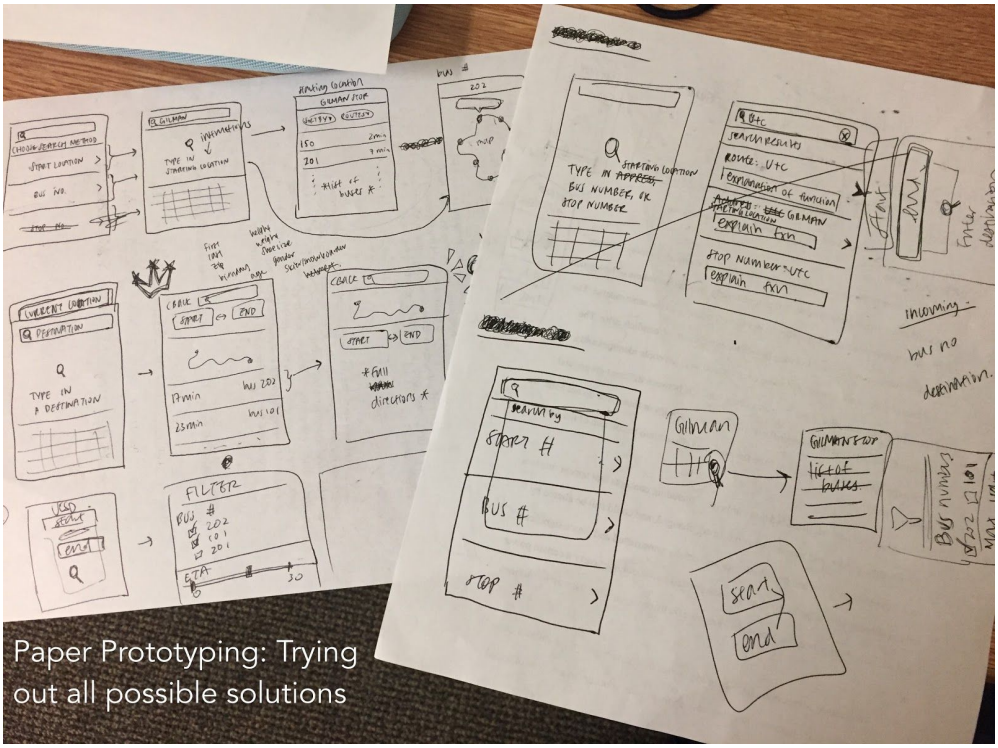
In the *develop* phase of the double diamond model of design, we came up with a list of possible solutions to make the search bar easier to use:

- search start and end location
- explain what each search option means, eg define "route", "address"
- choose which bus stop manually first
- search anything in the search bar, categorize results into bus stops and bus routes
- more filter options to find the right bus
- give estimated travel times
- provide more accurate error messages

- show all possible routes from start to end location
- display ranking of all possible routes according to preference (from filter options)
- display ranking of all possible routes from fastest to slowest
- include option of showing multiple buses in one route
- include walking directions— not just start to end bus stops but start to end locations

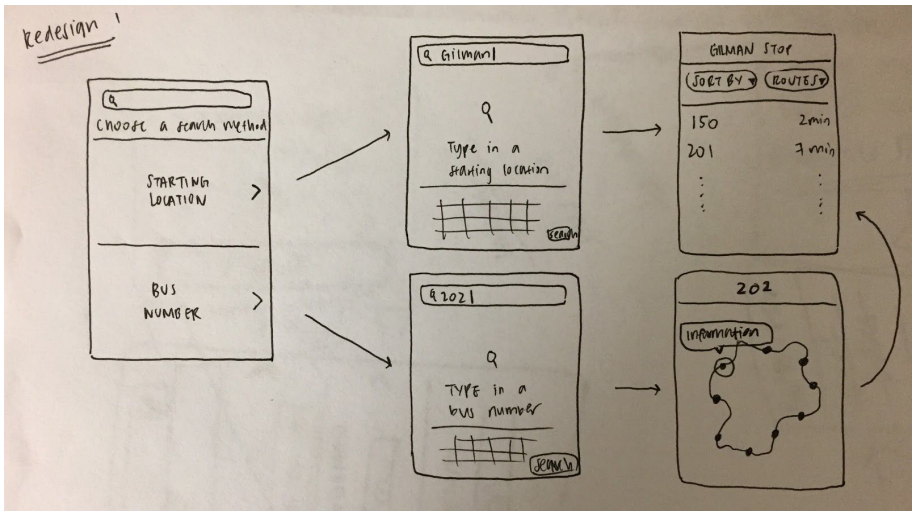
Paper Prototyping

After coming up with the list of solutions, we transitioned onto paper and roughly sketched out what each function would look like on the app. From there, we established three different iterations of a redesigned search bar. After solidifying our thoughts onto paper, we then used Sketch to create high-fidelity mockups of our three redesigns.

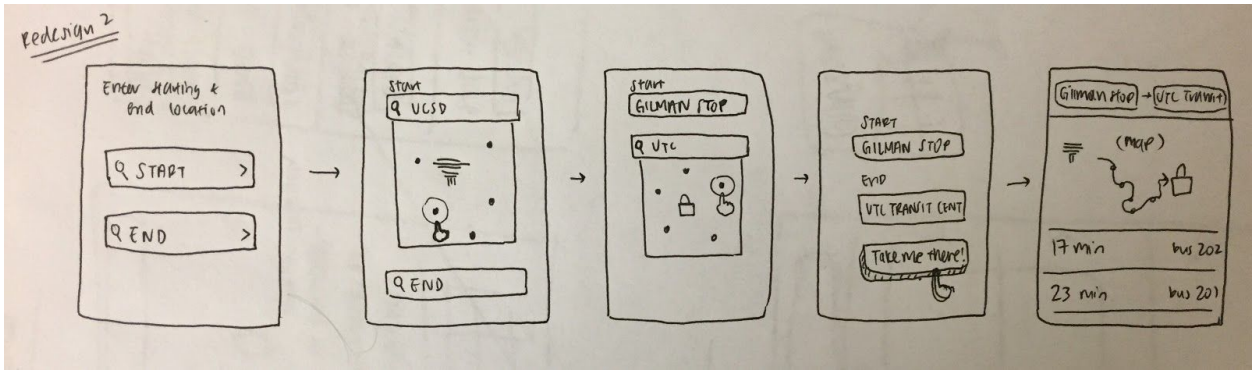


Paper Prototyping: Trying out all possible solutions

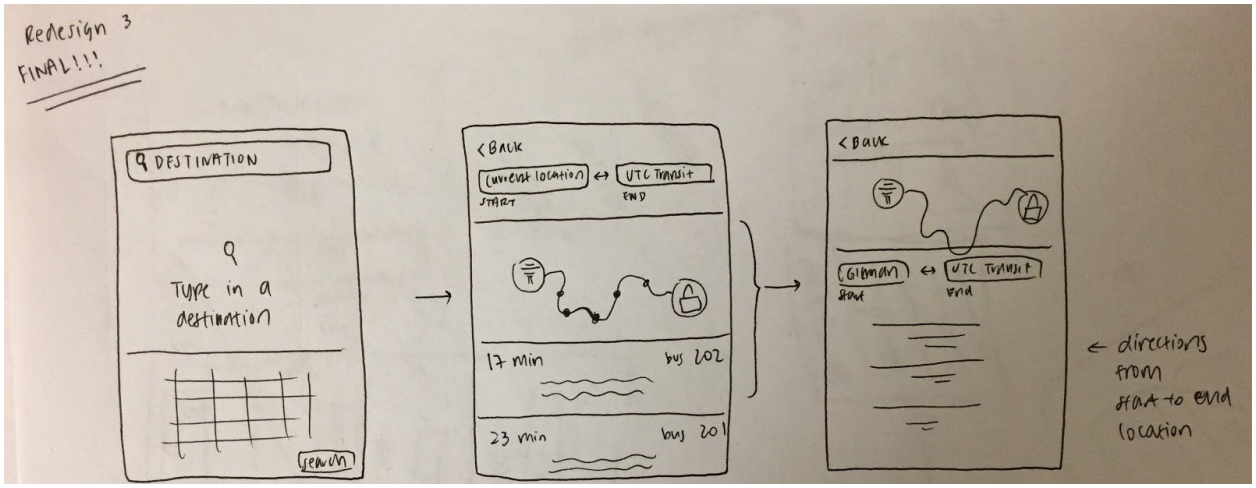
Redesign 1: Paper Prototype



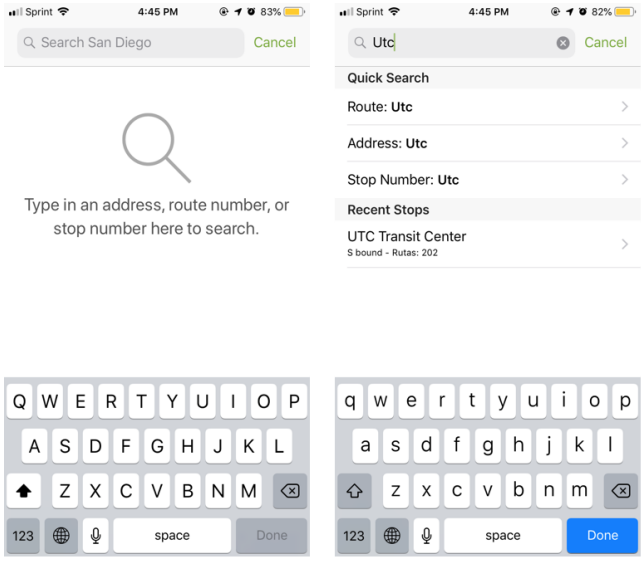
Redesign 2: Paper Prototype



Redesign 3: Paper Prototype

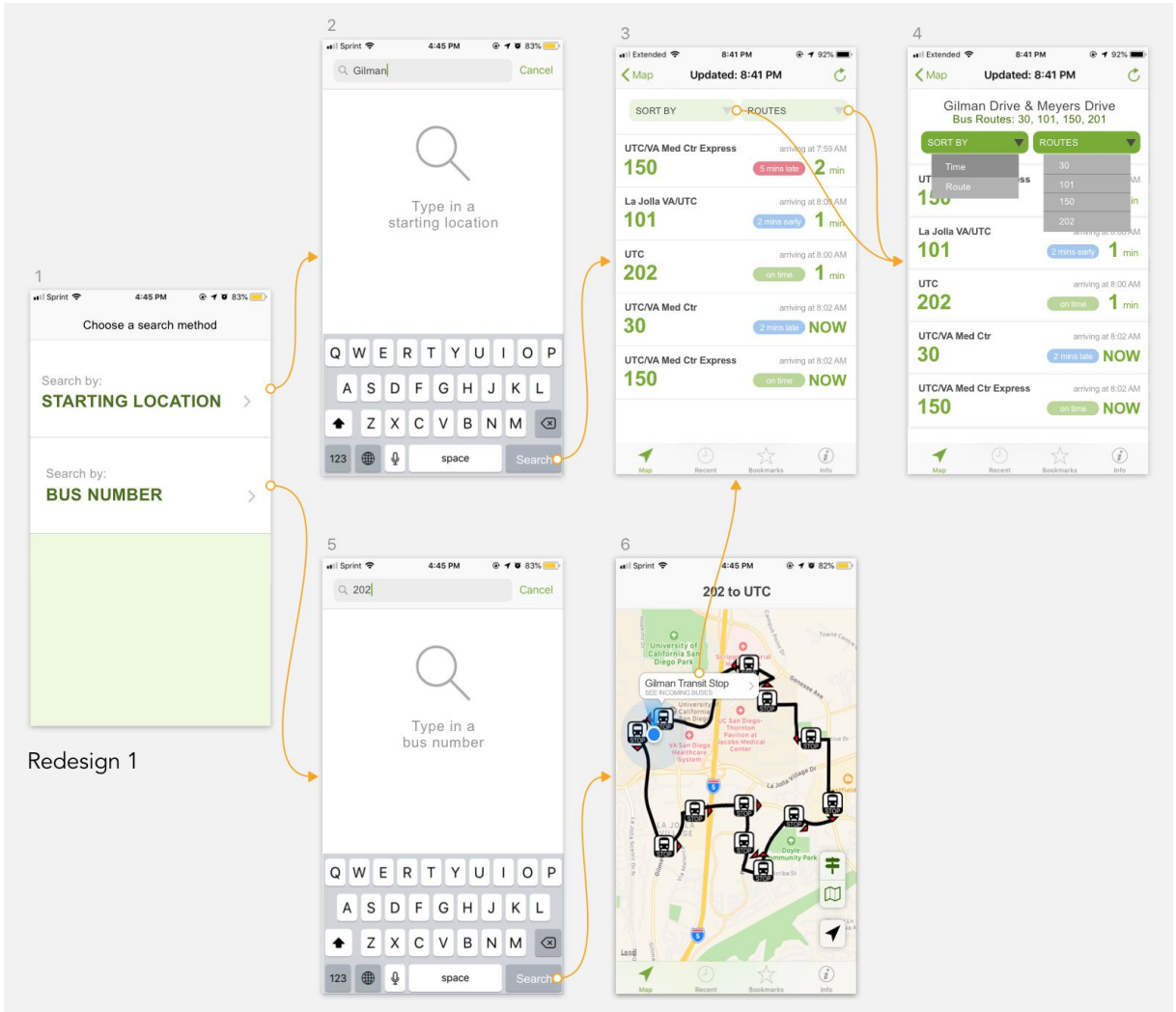


Redesign 1



Original: Search options are limited to route, address, or stop number.

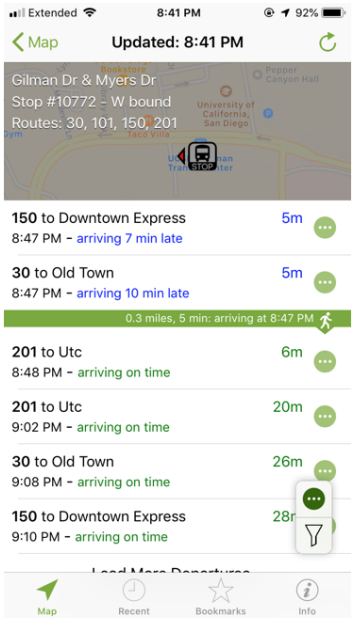
The original search bar limits the search options to three different categories: route, address, or stop number. The wording of each of these options, as seen from our data, confuses users. There is a lack of signifiers explaining what function each option affords, so users continually make mistakes when searching for their desired destinations.



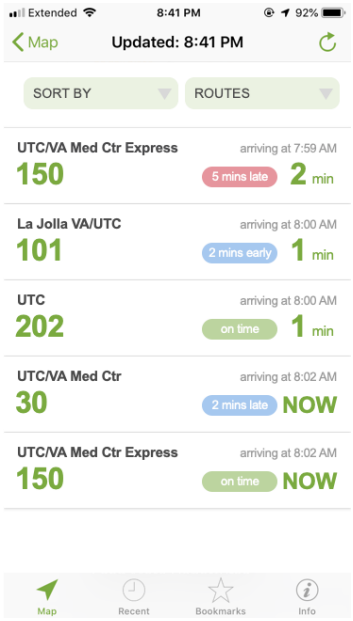
Redesign 1

In redesign 1, we wanted to see if redefining the search options would allow users to have a better understanding of what each option does. To do this, we changed the three options (route, address, and stop number) to two options: a starting location and a bus number. The wording of the options is much better than the original because "starting location" indicates that users should enter the bus stop where they would get on the bus, and "bus number" indicates that users should enter a specific bus number like "202" or "201". We took away stop number because it was not something that a user would know or memorize (Ex. Giman Dr & Myers Dr stop number is #10772).

In the original search bar, users were allowed to type their search query before selecting a search option. In this redesign, we reversed this process to ensure that users knew what specific input was required. The remaining screens show the same information as the original app, but we redesigned it to make it look less cluttered. In the third screen *(see right)*, for example, the buses are labelled differently than before and allows users to clearly identify the most important information: which bus is coming next and when it will be here.



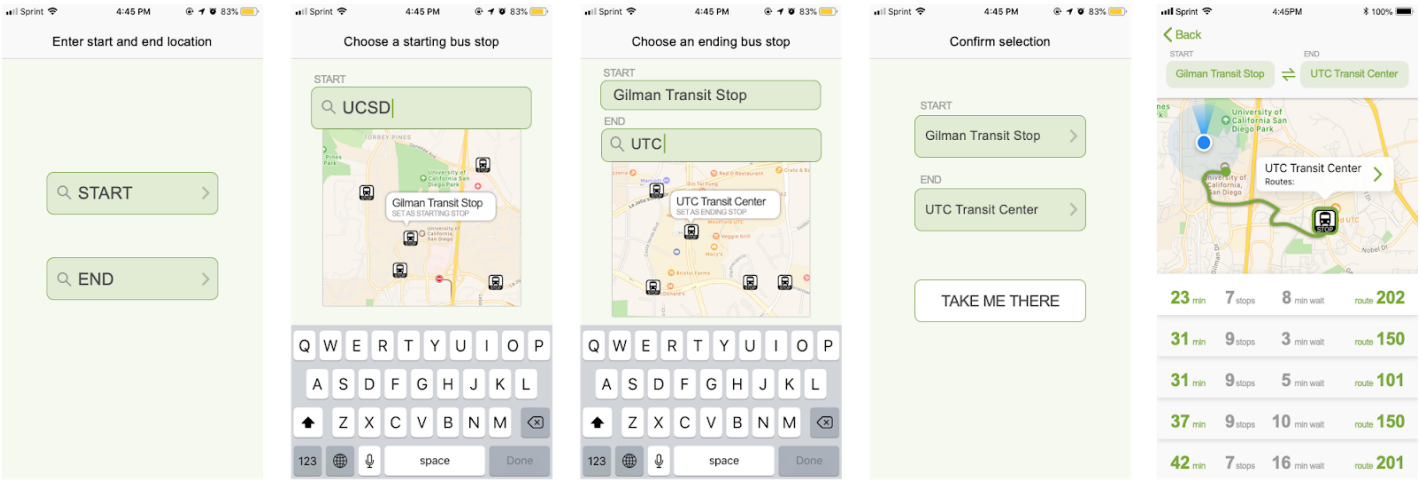
Before (original)



After (redesign 1)

Redefining specific search options and adding instructions for each option ("type in a starting location/ bus number") in this redesign increases the discoverability of the app's affordances. Decluttering also increases the compactness of the app, opting for a more clean and aesthetic look. In this redesign, users are able to easily search up a bus stop or number and clearly identify when the next bus is coming. However, it doesn't effectively allow users to find the most efficient bus routes from point A to point B without any prior knowledge of specific stops or bus numbers to search for. Thus, we moved onto redesign 2.

Redesign 2



Redesign 2

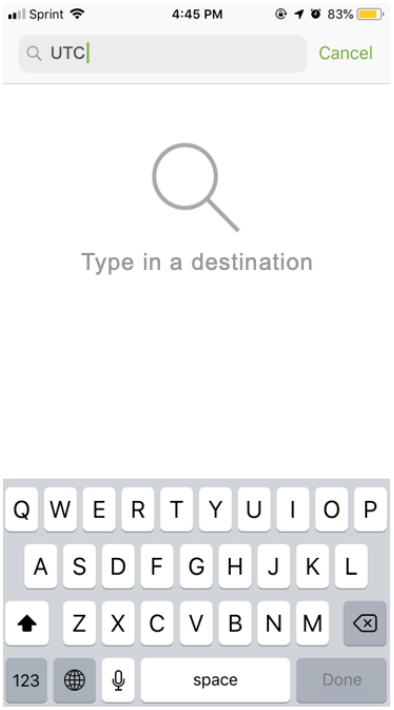
This redesign focuses on finding the most efficient routes from a starting to an end location. After tapping the search bar on the home screen, the first screen on the left shows up. Users are prompted to enter a start and end location, and when tapping into each bar, users are able to enter any location, instead of a specific bus stop like before. A map shows up of the searched location and displays five surrounding bus stops. Users will select one of the bus stops to become the starting bus stop, and repeat the same process to select the ending bus stop. After confirming their selection, a list of all possible routes, ranked from fastest to slowest, is displayed.

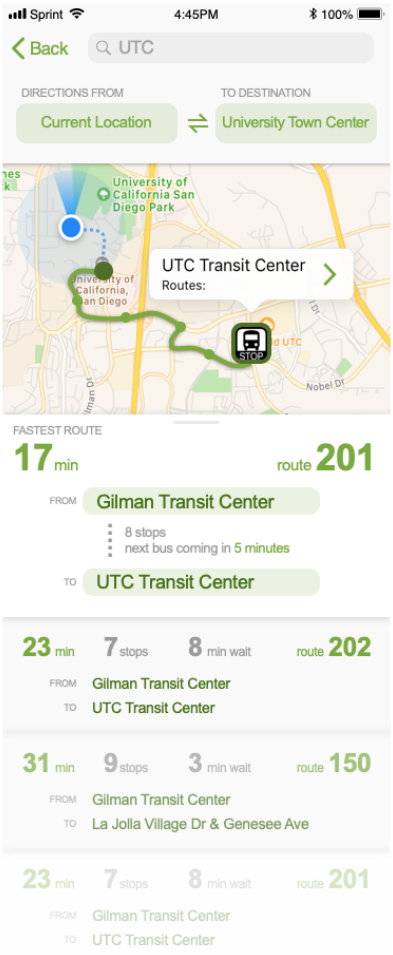
The visibility of the app, or the amount of information available to the users, increases with this redesign because the closest stops to the searched location is displayed. The user flow is similar to redesign 1's, where instructions for search entries are given to the users before they start typing for locations. This allows the users to understand what information the search bar is capable of processing and allows the users to understand the designer's conceptual model a bit better.

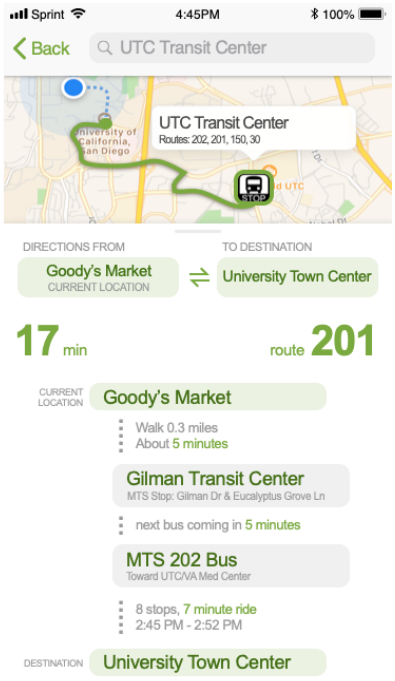
This redesign tackles the main issue of users not being able to find efficient routes. The list of bus routes going from the start location to the end location not only allows users to see all the possible routes they could take, but also gives an estimated travel time, estimated wait time, and ranks these optional routes from fastest to slowest. Providing these extra bits of information also increases the visibility of the app while allowing users to

find efficient routes much faster than the original design. The compactness is improved as well, given that the information displayed is organized and easily identifiable. The issue with redesign 2, however, is that some specific stops would not have any buses leading to other specific stops. If this is the case, users would need to repeat the process of selecting bus stops over and over again until the starting bus stop has buses going to the ending bus stop. To address this issue, we moved onto redesign 3.

Deliver: Final Redesign







Final redesign

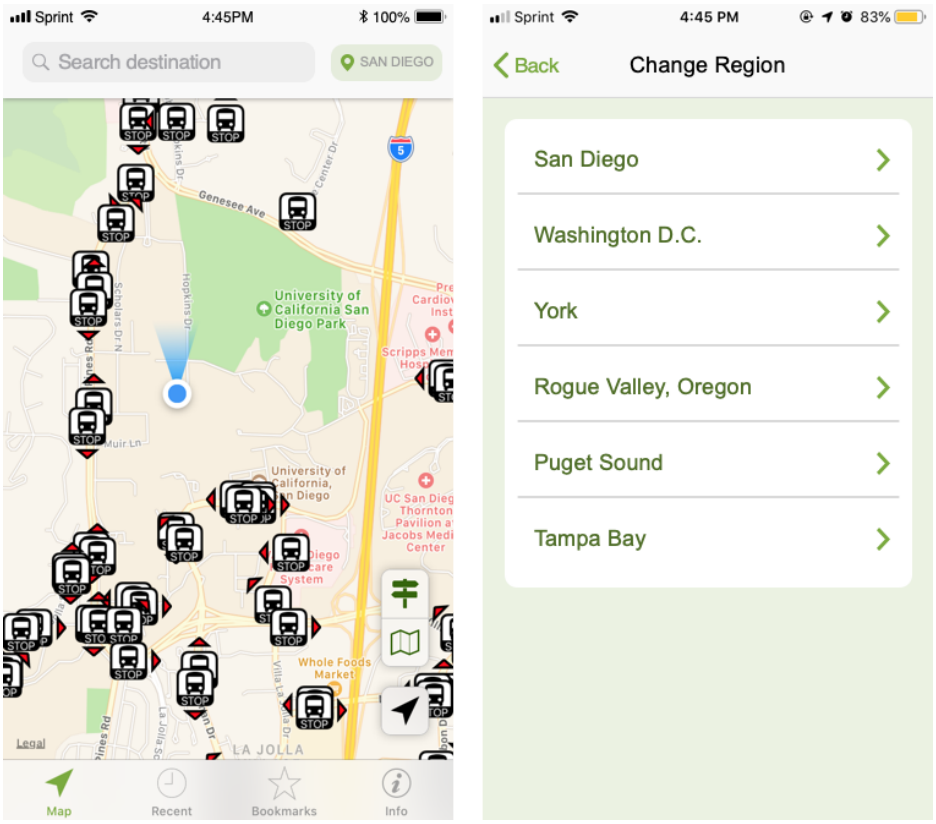
The final redesign introduces essentially an all-encompassing search bar. It's flexible and allows users to search up any destination. This assumes that users would only use the search bar to find a specific destination. We believe that this is a safe assumption to make because 18/18 of our participants searched up the destination "Westfield UTC" from our

interviews in order to find a bus that takes them to UTC. Clearly, the user's mental model of the search bar includes the affordance of searching up the destination. In this redesign, after users enter a location, the app automatically finds efficient routes from the starting location to the entered destination (*second screen*). The starting location is the user's current location by default, but could be changed by tapping on the green bubble marked as "Current Location". The destination could be changed in the same way if users wanted to search for another destination. Again, the routes are ranked from the most efficient to the least, allowing users to choose which route they would like to take. After clicking into a selected route, specific instructions (third screen) are given to guide users from their starting location all the way to the end location.

One major difference from the previous design is the starting and ending points. In previous designs, including the original, the starting and end points were always bus stops. However, in our final redesign, the starting and end points are now locations such as "Goody's Market". Specific directions would guide users from these locations to the bus stops, providing not only bus information but also walking directions. We made this change because setting locations as starting and end points makes the app even more user-friendly than before, since the user's mental model of using the app is to get from location A to location B. This can be seen through the participants' actions of searching "Westfield UTC" into the search bar instead of "UTC Transit Center", the name of the bus stop at UTC. The designer's conceptual model is to display the bus information from bus stop A to bus stop B, but this does not match up the user's intentions of using the app. By allowing users to enter specific locations, our final redesign successfully closes the gap between the user's mental model and the designer's conceptual model. The list of efficient routes would encompass all surrounding bus stops from the starting and end locations, factoring in estimated wait and walking times outside of the overall bus travel time.

Another feature we incorporated into the final redesign addresses another significant problem we identified within our interviews: changing regions. To address this issue, we decided to make this option more apparent for users by adding a button next to the search bar on the home screen. The button includes a location icon and displays the current region that the user is in, suggesting to users that the button is able to change the

current settings and direct the users into a different region. We decided to add a button instead of simply letting users drag around on the map because One Bus Away currently only offers its services to six cities. The designer's conceptual model was to have users manually change the setting because the app does not work in the majority of U.S. cities. Letting users zoom in and out of the whole map of the States would convey that the app has information about bus routes throughout the country, whereas including this button suggests that there are only a small list of cities that this app works in.



Final Redesign: Changing Regions

We settled on this redesign as the final design because it increases visibility, increases discoverability, and increases compactness. Visibility is increased because users can know the best and fastest routes to take. Information about estimated travel times, estimated wait, and specific walking directions are given to ensure that users get to the right destination. This redesign carries the most useful information without sacrificing the overall compactness of the app. The abundance of information is organized well and

displayed in a clear manner. The use of color contributes to presenting the information in a organized and decluttered way. Users are able to identify key information fairly quickly because they are always highlighted, bolded, or bigger than the other text. By adding a button for changing locations, users can also clearly identify which region the app is currently searching in. Ultimately, discoverability is increased in this redesign. We eliminated multiple search options and prompted users with only one instruction: *"Type in a destination"*. This eliminates any confusion or misunderstanding about different types of search options because now, there is only one possible way to find an efficient route. Users can now easily understand what to type into the search bar and what information they will obtain in doing so. With the addition of the button for changing regions, users are able to better distinguish the geographical limitations of the app's services, as opposed to randomly zooming in and out on the map, hoping that bus routes would magically appear.

There is perhaps one trade-off with this design: a flexible search bar requires a complex algorithm of identifying locations that would be costly to develop. In our final design, high discoverability and high visibility also comes with low affordability. This redesign would require grouping bus stops to locations instead of simply matching specific inputs like before. For example, when searching for "Fashion Valley", all the surrounding bus stops at Fashion Valley would be calculated into the possible route options. Each bus stop would need to be re-defined to be included into all possible search terms, and this algorithm would require a lot of effort to develop. However, the process of searching up a bus route in this redesign is so intuitive and user-friendly that we think it is worth the time, effort, and money to adopt our redesign.

IV. Design Space

Trade-Offs

Visibility vs. Compactness

From interviewing participants, it is evident that there is a trade-off between visibility and compactness. Our group defines visibility as the amount of information that is visible to the users. Meanwhile, we define compactness as how well the app achieves a clean and minimalistic look. This is because a major benefit to mobile apps is that it has the ability to condense information onto a smaller screen. In the case of One Bus Away, the visibility is high because not only is the home screen able to show all the bus stops on the map (*Figure 14*), the search bar allows users to identify when buses are arriving at each stop and where each bus route goes (*Figure 15*). However, because there is an abundance of information, it sacrifices the compactness of the screen. 13/18 participants noted in the interview that the home screen looked overwhelming, as the app showed every bus stop around them. Furthermore, because bus stops were so close in proximity, the bus stop icons would also overlap if the user did not zoom into the screen enough. In addition, unlike other transit apps where it would only emphasize the fastest route to the desired destination, the One Bus Away app provides the user with every single bus that goes through the starting location. However, the only bus that should be shown is the one that takes a user to the destination the quickest. These two features make the app look extremely cluttered, which is why our group gave it a 1 for compactness. However, the designers are sacrificing

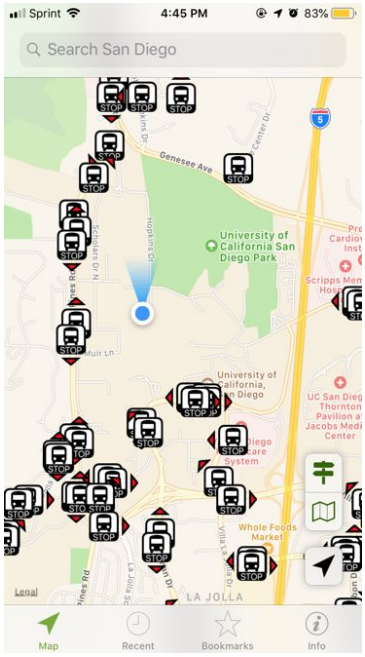


Figure 14: High visibility

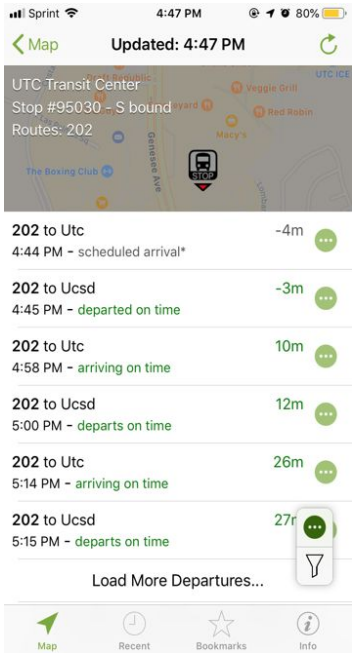


Figure 15: OneBusAway Incoming Bus Times

compactness for visibility. The app deserves a 4 for visibility because it provides users an abundance of bus options, as well as detailed information about each bus. On the flip slide, if an app were to have low visibility, it is more likely that the app would be more compact as there would be less information to show on the screen.

Transit Apps	Visibility (1= low, 5 = high)	Compactness (1= low, 5 = high)
One Bus Away (Redesign)	5	5
One Bus Away (Original)	4	1
One Bus Away (Android)	4	2
Google Maps	5	5
Apple Maps	4	5
UCSD App	2	4

This design space compares the visibility and compactness of 6 different apps: One Bus Away (redesign, iOS, Android), Google Maps, Apple Maps, and the UCSD app. (Screenshots of each app are in the *Appendix* at the end of the document.) As shown in the design space above, the iOS (original) version scores a 4 for visibility and 1 for compactness because although there is an abundance of information about buses on the app, it looks extremely cluttered (*Appendix A*). The app includes every single bus stop on the map and shows a disorganized list of all incoming buses in each stop that makes the most important information difficult to find. It did not get a 5 for visibility because other transit apps offer a lot more information such as estimated travel times and walking directions to each location. Similarly, we scored the Android version of the One Bus Away app a 4 for visibility and 2 for compactness (*Appendix B*). Both the Android and iOS versions include the same information; however, it scores slightly better in compactness because the bus stop icons are smaller. Instead of a bulky square bus stop icon found in the iOS version, the Android version utilizes a smaller dot to signify a bus stop. In turn, the screen looks less overwhelming to the user. Furthermore, when looking at incoming buses, each piece of information uses a different font size and color so that the important

information, such as estimated wait and bus number, is easily identifiable. This makes its compactness a bit higher than the iOS version of the app.

We chose to include the UCSD app into the design space because it is also a transit app, but for campus shuttles. We scored the app a 2 for visibility and a 4 for compactness because although the app looks very minimalistic, it does not offer the user the level of information that One Bus Away provides (*Appendix C*). The sole icon on the map is the starting stop, making the app look clean, but the app does not inform users when the bus would arrive at a destination. It is evident that the UCSD app is an example of the flip side of the visibility vs. compactness trade-off. As such, though the app is compact, there is not a lot of information provided to the user.

Furthermore, we also included Google and Apple Maps into the design space because they are the most frequently used transit apps among participants. When asked what transit app participants used, 18/18 participants mentioned either one of these apps in their interview. We rated Google Maps a 5 for visibility and compactness because the interface looks extremely clean, yet is still able to show users the necessary information to navigate to their desired destination (*Appendix D*). Google Maps allows users to select whether or not they want to arrive at their destination by car, bus, foot, bicycle, and Uber/Lyft. Furthermore, the app provides users with the fastest route to the destination. Essentially, Google Maps fits the best case for a transit app. Meanwhile, we rated Apple Maps a 4 for visibility and a 5 for compactness because though the app pulls off a minimalistic look, it offers slightly less information than Google Maps (*Appendix E*). Apple Maps mostly provides the same features that Google Maps offers; however, a difference we observed is that Apple maps does not inform users the cost of taking a bus to a destination. Furthermore, we also noticed that Apple Maps does not allow users the option to see how long it would take for them to bike to a certain destination. As a result, taking in account the disparities between the two apps, our group decided to score the visibility of Apple Maps slightly lower.

For our redesign, we gave it a 5 for visibility and 5 for compactness (*Appendix F*). In terms of visibility, the new function of showing all possible routes, ranked from fastest to slowest, gives users even more information than before. In terms of compactness, the

redesigned search bar looks minimal and clean, allowing users to identify important information easily. In many ways, the functions of our redesign closely resemble that of Google maps because offering efficient routes is a rather popular affordance for transit apps.

Visibility vs. Discoverability

Another trade-off we discovered from looking at the interview responses was visibility vs. discoverability. Again, we define visibility as the amount of information that is visible to the user. On the other hand, we define discoverability as the ability to figure out what actions are possible and how to perform these actions. The app scores low in discoverability because though the developers incorporated many features into the app (all possible buses, changing regions, etc), it is difficult for users to find these features and utilize it effectively. For instance, the app's search bar has a low discoverability because it does not effectively communicate to the user what the options "route" and "address" means. The different options, as discussed earlier when identifying the problems of the app, confuses users and do not offer enough signifiers to communicate each search option's affordance.

In addition, the One Bus Away app does not immediately tell users which bus would take them to the destination the fastest; it only shows which bus would arrive to their starting point first (*Figure 16*). As such, to find the quickest and most efficient route to Westfield UTC (activity 1), the users would need to manually click into all of the possible buses that show up and scroll down to see when each bus would arrive at their destination. As mentioned earlier, participants ended up just picking the bus that came to the starting bus stop the earliest. This is because with a destination like Westfield UTC, there are multiple buses that would take them there, so the user would

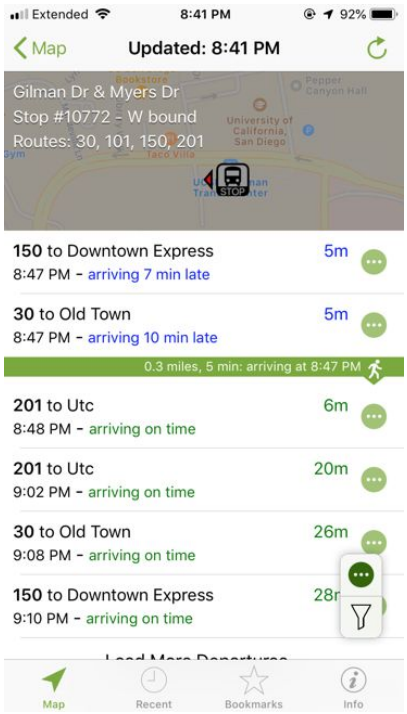


Figure 16: OneBusAway Incoming Bus Times

have to go through every single bus and compare the times to each other.

Furthermore, another aspect of the app that shows low discoverability is changing regions. As discussed in the problems section, 18/18 participants were initially unable to figure out how to change regions to Washington D.C. The correct way of doing this action would be clicking the settings icon on the bottom and manually change the setting Washington D.C.

Taking this all into consideration, these issues relating to discoverability all existed because of a difference between the designer's conceptual model and the user's mental model. As such, our group ranked the discoverability as a 1 but gave the app a 4 for visibility because although information may be hard to find and digest, the amount of information that could be visible to the user is still high. On the flip side, if an app were to have high discoverability, it would probably have to sacrifice visibility because there would need to be less information visible to the user for the user to understand how to perform the actions.

Transit Apps	Visibility (1= low, 5 = high)	Discoverability (1= low, 5 = high)
One Bus Away (Redesign)	5	5
One Bus Away (Original)	4	1
One Bus Away (Android)	4	1
Google Map	5	5
Apple Map	4	5
UCSD App	2	1

The design space above also compares the same six apps, but for the trade-off of visibility vs. discoverability. Both the iOS and Android version score a 4 in visibility because it provides an abundance of information about bus stops and buses, but not as much as other transit apps like Google Maps which give an estimated travel time, travel costs, etc (*Appendix A and B*). As mentioned in the trade-off above, the iOS app version scores a 1 in discoverability because it is difficult for users to find and execute certain actions within the search bar. Similarly, when our group played around with the Android version, we found the same issues that were a problem in iOS version. As such, we also ranked it a 1 for discoverability.

Meanwhile, for the UCSD app, our group ranked it a 2 for visibility, but a 1 for discoverability (*Appendix C*). As explained earlier, the UCSD app does not offer the user an abundance of information about campus shuttles, such as when the shuttles would get to the user's desired destination. However, in this case, the app is also not sacrificing the discoverability. From playing around the app, our group thought that it was confusing to

use because of the lack of effective signifiers; we did not realize that tapping the circular icons would take the user to a map of where the stop location is. Furthermore, there is no search bar for the user; users are not able to manually type in their start and end destinations. This makes it extremely difficult to find and understand where each shuttle route would start and end. As such, it is clear that the UCSD app would fall under the worst case on the graphical representation of the design space.

In contrast, Google and Apple Maps score a 5 and 4 for visibility and both 5s for discoverability because of their use of effective signifiers (*Appendix D and E*). The different icons for bus, foot, bicycle, and uber/lyft is very clear, causing no ambiguity to the user. The search bar functions are easily discoverable. For these two apps, users are able to search anything without constraints and be able to find efficient routes from point A to point B, using almost any type of transportation method possible. There is only one possible way to search anything, which is far less confusing than the three options provided in One Bus Away's search bar. Furthermore, when users type in a destination, both apps make finding the most time efficient bus route more discoverable by either labelling it as "Recommended Route" or putting the fastest bus route first with the calculated time to get to a destination in bold. These signifiers cause users to immediately know what bus they should take to get to their destination. This is unlike One Bus Away, as the app would just show all of the possible buses on the screen and users would have to manually tap into each bus to see which one would get to the destination the fastest. Thus, it is evident that Google and Apple Maps have a high discoverability because the apps are able to effectively communicate to the user what bus they should take at a very quick glance. Again, as stated earlier, both apps have relatively high visibility because it provides users with important information regarding the bus routes.

We gave our final redesign a score of 5 for discoverability and a 5 for visibility (*Appendix F*). As explained earlier, visibility is a 5 for our redesign because the amount of information available drastically increased due to the new feature of displaying efficient routes. We ranked our redesign a 5 for discoverability because the search bar is now very intuitive to any user input. The functions of the search bar are easily discoverable, since it accepts a destination as an input and follows the user's mental model, returning a list of

efficient planned routes. By eliminating confusing search options like the original design, the affordances of the search bar is now easily discoverable. The instruction given, "Type in a destination", is straightforward and clear (*Figure 17*). With this signifier, users would now understand how the search bar works and how to find efficient routes much faster than before. Lastly, our redesigned way to change regions has a much more effective signifier, as there is a green button on the upper right hand corner of the home screen. Participants would click on the button and see the available locations they can go to on the map.

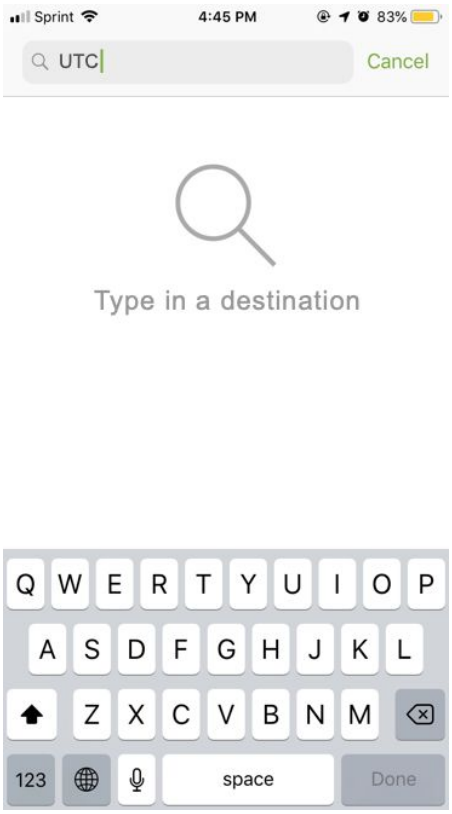


Figure 17: Redesigned Search Bar

V. Conclusion

The app One Bus Away is an example of how important it is for the designer's conceptual model and the user's mental model are bridged. In order for the designers to effectively do so, we encourage them to open a channel of communication between the designers and users. In turn, this would enable for the app developers to gain valuable feedback and redesign their app based on it. As a next step, we also recommend One Bus Away developers to make the app more uniform between the Android and iOS versions. This is especially important now, as the new and updated version of One Bus Away is currently a beta version, so they could immediately add these changes.

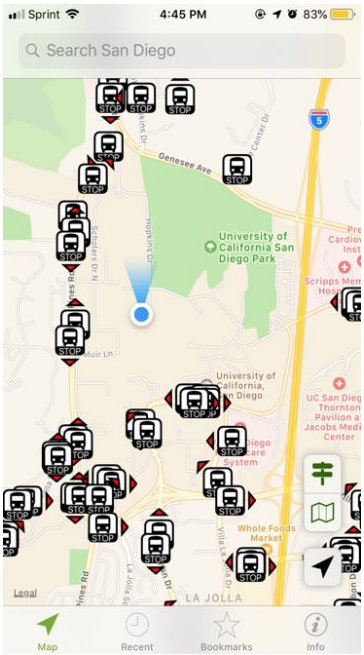
Additionally, we would try to pitch our redesigned One Bus Away app to the UCSD ProtoLab, which is currently working closely with MTS to create transport solutions in San Diego and beyond. It is imperative to redesign this app immediately since it is the first bus resource advertised to people, many of whom are students, who have never used the transport system in the area.

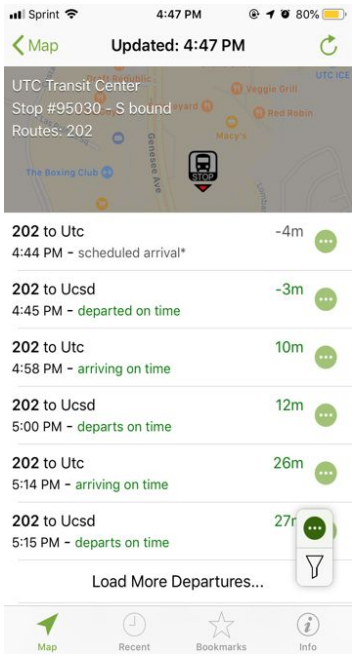
This project was valuable, as it depicts the importance of user feedback, and also, allowed us to redesign a real app that had often been a source of frustration. Additionally, we noticed how we began to utilize the design concepts that we had learned in class. For example, we, unintentionally, structured this entire project according to a double diamond design, and later when we realised we had, we noticed how this only began to happen after we learned about the concept in class.

We, also, utilized multiple techniques mentioned in *The Little Book of Design Research Ethics* by *Jane Fulton-Suri*, in order to create a comfortable interviewing environment for our interviewees, and reduce our bias. In conclusion, we believe that this project really made us recognize the value of this class, and how important it is to understand important design concepts before anyone creates their own designs.

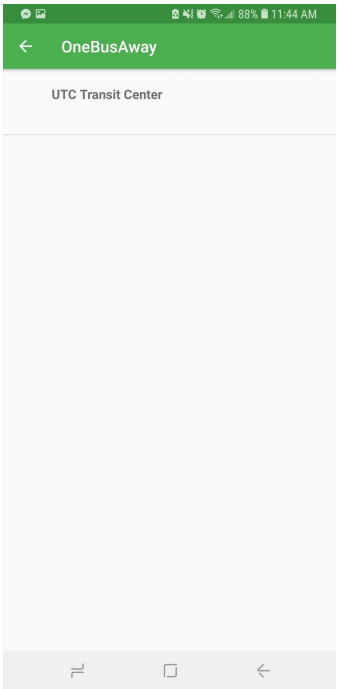
VI. Appendix

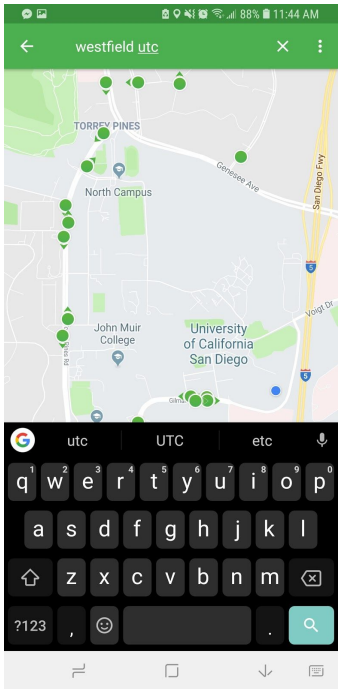
Appendix A: One Bus Away (iOS version)

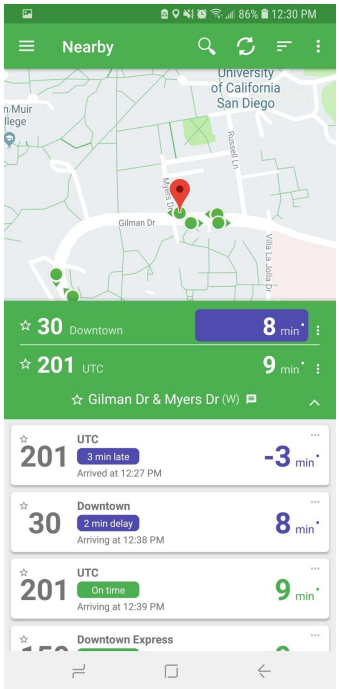


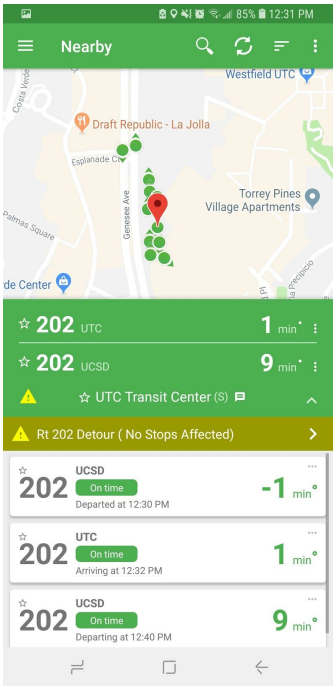


Appendix B: One Bus Away (Android Version)

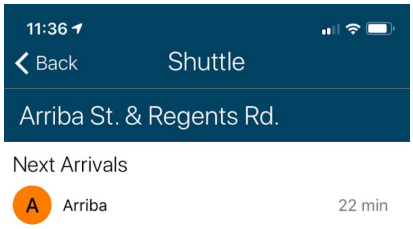


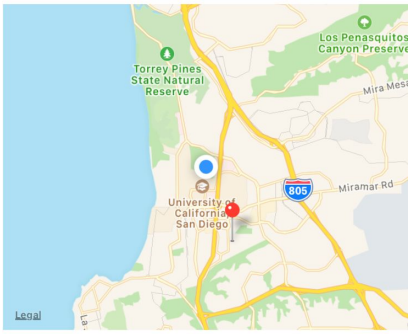




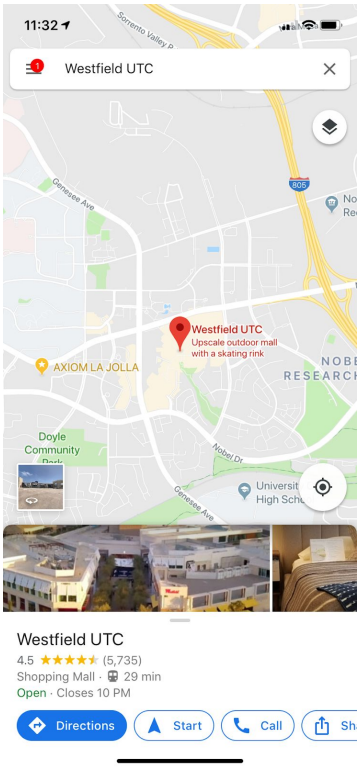


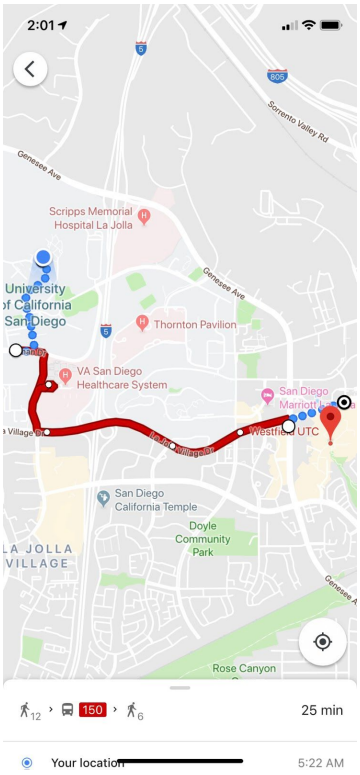
Appendix C: UCSD App

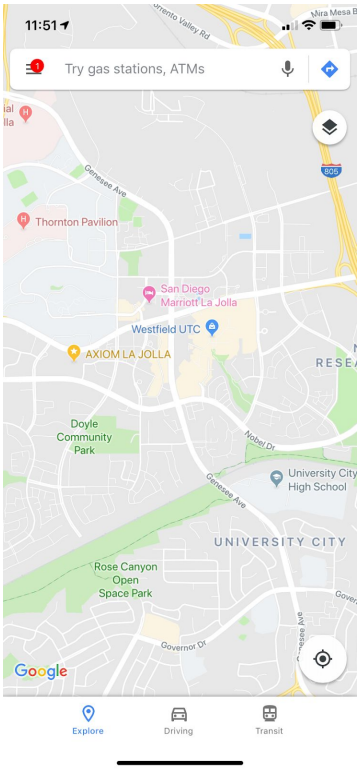




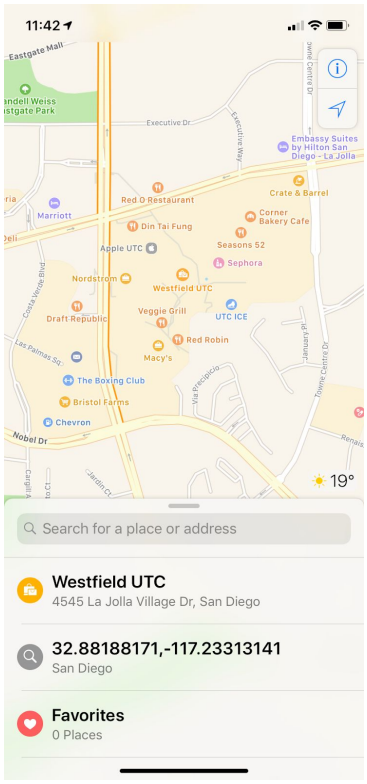
Appendix D: Google Maps

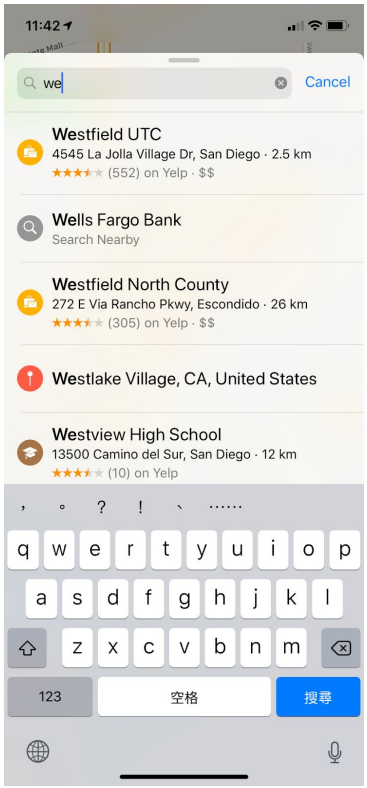


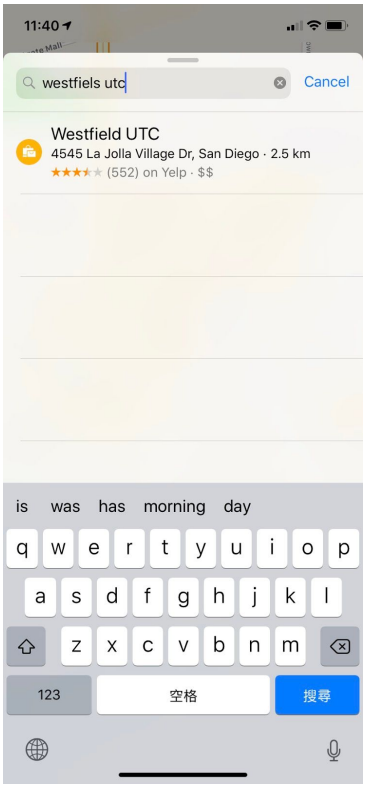


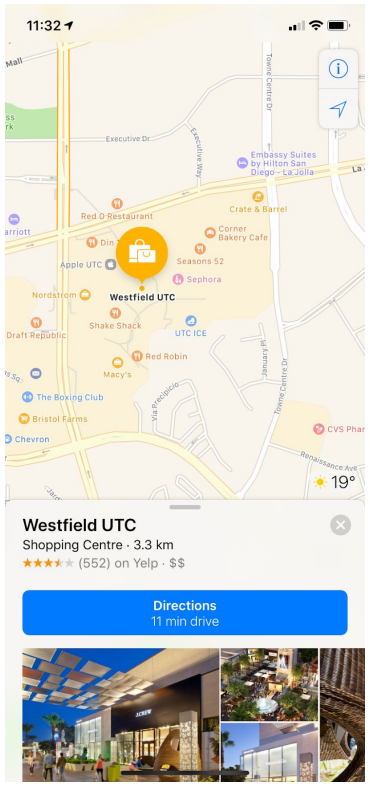


Appendix E: Apple Maps

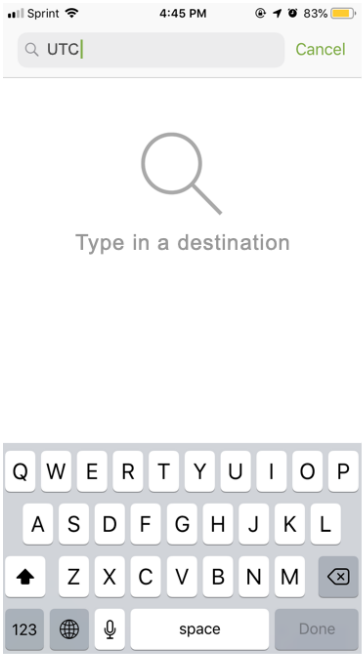








Appendix F: One Bus Away Final Redesign



Final redesign