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## GR0: Problem Statement

Rather than owning a car, or taking public transport, another option for getting around a busy city is biking. Chicagoan bikers, and other inner city commuter bikers, bike to get to their location efficiently, effectively and safely. Having the option of avoiding parking fees and traffic congestion is a luxury for those who travel around the city frequently and need to get to their destination quickly and cheaply. Current infrastructures sometimes don't allow for these goals to be reached due to lack of reliable bike lanes, lack of visibility of bikers in the city, and lack of safe places to lock up bikes when getting to their destination. Alongside this, in Chicago, bikers often face problems of temperamental weather conditions, which can cause rapidly changing road conditions. This makes it difficult to find a quick place to shelter and lock up their bike until the weather clears up.

# GR1: Project Proposal and Analysis

## Problem Statement

Rather than owning a car, or taking public transport, another option for getting around a busy city is biking. Chicagoan bikers, and other inner city commuter bikers, bike to get to their location efficiently, effectively, and safely. Having the option of avoiding parking fees and traffic congestion is a luxury for those who travel around the city frequently and need to get to their destination quickly and cheaply. Current infrastructures sometimes don't allow for these goals to be reached due to lack of reliable bike lanes, lack of visibility of bikers in the city, and lack of safe places to lock up bikes when getting to their destination. Alongside this, in Chicago, bikers often face problems of temperamental weather conditions, which can cause rapidly changing road conditions. This makes it difficult to find a quick place to shelter and lock up their bike until the weather clears up.

## Observations and Interviews

### User 1: "Claire"

Claire is a college-aged student who regularly bikes, using her own personal bike, from her apartment and then to her classes and she additionally bikes for recreational purposes including on trips into the loop, and for more casual bike rides along the lakefront. She primarily bikes when the weather is nice, primarily when there are no giant rain storms or if there isn't snow/ice on the ground. Temperature is less of a concern when biking for Claire as normally she bundles up when it is cold and she states it feels better to bike than to wait for a bus. The only other time she prefers to not bike is when she has injured herself or is going somewhere where she knows there isn't a good place to park her bike without it getting stolen, or that it is an unsafe area.

One of the main reasons Claire prefers to bike is general convenience. It is nice to know that if she needs to get back to her apartment she can do so fairly effectively and she knows the main routes home and having a bike she doesn't have to wait for a bus, something that has become a problem over time as CTA buses have become less reliable for her. Additionally, she finds it safer and easier to bike home rather than waiting for a bus or walking, particularly at night after work or classes.

In our discussion, one thing that was noticed was the amount of equipment and problems that arose with it. While some items were small they were necessary to increase personal safety while riding. For example, having to carry the bike helmet, conveniently clipped onto the bike though cumbersome to carry around meant having that additional element for safety while riding. Another item that was important was a bike light and during our interview, it was noted that it was not operating properly which meant it was not ideal for biking at night due to the low visibility of drivers. This meant Claire had to go out and buy batteries, and as we

discussed later she had to buy a new light after she realized the one that was on her bike was broken. She assumed it broke due to a rainstorm.

In terms of patterns in riding, Claire tries to stick to the paths she is used to, however, she noted sometimes items such as construction change her routes, or she will try to avoid busier streets during rush hour, particularly the Roosevelt & Halsted intersection. Additionally, recently she has also become more aware of the weather and wind when she is riding, as one recent ride the wind nearly pushed her into the lake. One of the main concerns noticed during our discussion was dealing with changing road conditions and ensuring that there was a safe route, with minimal road problems, such as potholes, and avoiding routes that don't have a designated lane/areas where buses might have to frequently pull over.

#### User 2: "Will"

Will is a casual commuter who commutes on his bike to do light grocery shopping and get exercise. He originally got his bike to commute to work, but then the pandemic hit and he has been working remotely ever since. He feels that getting around on a bike is not only faster than driving, during peak traffic hours, but it is also good exercise and better for the environment. He lives in the suburbs of Chicago now, where there are few to no designated bike lanes, and where neighborhoods are very quiet and dark at night.

He cites that riding after sun down to the grocery store or gym feels riskier because visibility is poor and a car might not be able to see him riding. Furthermore, although he checks the weather ahead of time, he has been caught in the rain still. For this reason he always keeps a rain jacket with him at all times, as well as sticking to only well known routes where he knows there are possible spots, like grocery stores, where he can stop to lock up his bike and step in for a while until the rain clears.

Will does not ride in the winter, due to cold weather and snow, and also wishes there was a way to know about sudden construction projects or inclement weather conditions along his usual routes. Something interesting that Will mentioned is that he only rides his bike on well-known routes, meaning ones that he has driven in a car on many times before, and to destinations that he has been to many times before. He rarely deviates from his usual route and only bikes to frequent destinations.

#### User 3: "Tom"

Tom is a student from India who recently moved to Chicago for a master program at UIC. He has more than 10 years of bicycling experience in India. Since he has moved to Chicago, he has been directly cycling from location A to location B such as going to school, grocery store, and exploring the city.

As he was describing the safety of inner Chicago's bike lanes, he mentioned that the lanes are great, but there are many people who also block the lanes such as pedestrians and drivers for Taxi, Uber, Lyft, Doordash, etc.

Besides that, many bike routes in Inner Chicago are one way and sometimes he finds it hard to navigate through the city due to those one-way lanes. Even though he mentioned that he uses Google Maps for navigation, sometimes it fails to tell him that the bike route is one-way.

Moreover, Google Maps also shows routes that do not have the bike route. (Helpful that Google Maps supports audible like stating take right turn on Street Chicago, Putting headphones while cycling in the City)

Essentially, he uses a bicycle everyday because it is cheaper than owning a car, efficient for everyday use such as exploring the city and going to school, and ultimately he thinks bicycling improves his overall health. Yet, he faces many issues such as losing his bike seat, or having a thought of losing his bike, and a lack of information regarding the city's safe routes.

P.S. the interviewee had also mentioned a safe routes with or without bike lanes from <https://mellowbikemap.com/>

#### User 4: "Kathy-Lynn"

Kathy-Lynn is a thirty two year old doctoral student. She is a long-time biker and currently bikes both for work (e.g. to commute to campus) and for fun (though predominantly the former). She will only bike during the non-winter months when the weather is nice. If commuting via bike, she will often take the quickest route regardless of traffic. Her regular commute to campus involves riding down a busy street and eventually switching into a bike lane for the rest of the ride. She generally plans routes ahead of time and memorizes them. Occasionally, on an especially long and unfamiliar route, she may stop to remind herself of the remaining directions. Although she feels that she is a confident biker in general, she is uncomfortable when she has to deviate from her route.

Safety is important to Kathy-Lynn. She doesn't plan routes around bike infrastructure, but it makes her feel happy and safe when using it. If she knows beforehand that a street has bike infrastructure, she goes out of her way to use it just to feel safer. Something interesting that Kathy-Lynn mentioned was that she feels safer biking with others rather than alone, especially with bikers who are more confident than her.

Though Kathy-Lynn would like to commute both quickly and safely via bike, she has not been able to strike a balance between the two. She is currently prioritizing quickness at the expense of safety, which makes her commute stressful.

#### User 5: "Judd"

Judd is a thirty five year old grocery store supervisor. He has been biking since childhood and used to commute via bike to work; he now mostly rides for fun or for errands as he feels he doesn't live close enough to his current employer to easily bike there. He never

plans his routes if he knows the area well enough to improvise his ride, though he may occasionally look up, say, the best exit from the Lakefront Trail to get to his given destination.

Knowing whether a street is bike-friendly/has bike infrastructure beforehand is a big factor in Judd's choice of improvised route. He prefers protected/separated bike lanes over other types, though, because they are safer; in his experience, unprotected bike lanes can be just as hazardous as biking in the street due to drivers not respecting or being mindful of them (e.g. cars parked in bike lanes, drivers hitting bikers when opening car doors, etc.). Something surprising that Judd mentioned was a preference for biking in denser areas; he feels that denser, urban areas are more supportive of bikers infrastructure-wise and that drivers are more predictable and accepting of his presence.

Ultimately, Judd wants to get to his destinations/enjoy his rides safely but feels that doing so is difficult due to lack of bike infrastructure or due to not knowing where existing infrastructure is on improvised routes.

## Summary

Through all five interviews one of the main reasons people decided to bike was convenience as well as general enjoyment of biking and getting a chance to be active while being productive (in regards to traveling). Some main areas of concerns and problems city bikers had were other road vehicles not seeing them, such as commuter cars, ubers/lyfts, and CTA buses. Another concern faced was with weather. Particularly in winter or rainy conditions, it was often reflected by users that these were conditions that they would avoid. Finally, another sentiment echoed among those interviewed was that routes that had safety measures in place such as designated bike lanes and protected lanes were appreciated.

## User Classes

1. Daily work/school commuter with strict time sensitive routes.
2. Casual errands commuter with relaxed time sensitive routes.
3. Exercise bikers with relaxed time sensitive routes
4. Exercise bikers with strict time sensitive routes
5. Commuters that strictly stick to the same routes.
6. Commuters that are open to improvising routes when necessary.
7. Recreational bikers, bikers who mainly bike for fun.

## User Goals

1. To save money.
2. To use biking as a form of exercise (User groups 3 and 4).
3. Minimizing time needed to get to a destination.
4. Minimizing mileage needed to get to destination (User groups 1, 2, 5, 6).

5. Getting to their final destination safely, with no bodily harm or harm to any material items.
6. For general enjoyment (User group 7)

## Potential Problems

1. Vehicles block bike lanes to either park, pass by, or open doors without paying much attention to incoming bikers.
2. Satellite maps and/or weather reports may not update quick enough and/or accurately.
3. New construction happening is not updated anywhere unless it is on a major highway or road.
4. Satellite maps may not show bike lanes in routes or at all, including up-to-date issues with them.
5. Lack of information on currently available bike infrastructure.
6. Unpredictable weather patterns in Chicago
7. Lack of road upkeep leading to unreliable road conditions

## Concluding Statement

Urban bikers have a wide variety of goals, and, likewise, they face a myriad of problems in pursuing them. Most users have similar feelings and desires regarding personal safety. The problems that a biker will face, however, depend on how strongly they value their commute time and/or route preferences or whether they have biking goals unrelated to their commute (e.g. exercise, enjoyment).

# GR2: Designs

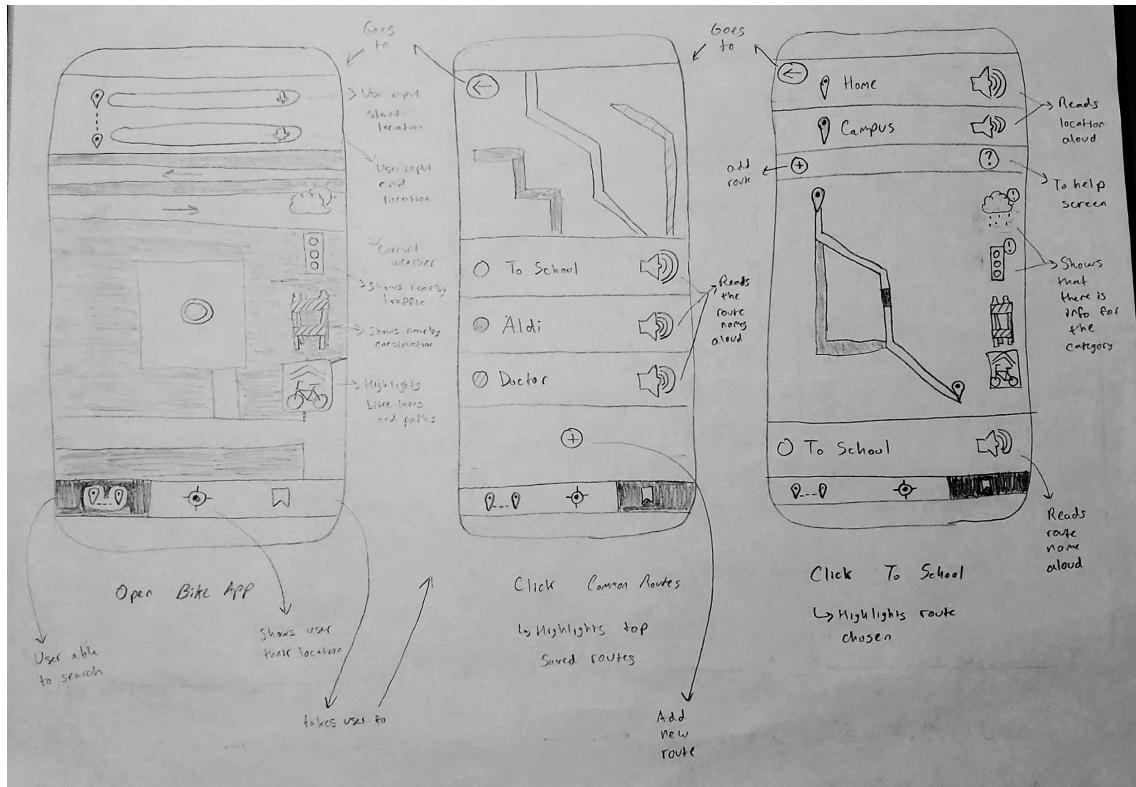
## Scenario

Jane Doe is going to her classes from her apartment via a bike, roughly a mile long trip each way, on a Monday morning, a routine trip for her. She is running late and is in a rush. Jane wants to make sure that she is able to arrive at school without injury and as quickly as possible (as she needs to attend office hours). She quickly takes out her phone to open the Bike App. She then clicks on the Routes "button." Then, she clicks on her named route School to see a snapshot of her route. This shows her a simple indicator of the weather conditions, in relation to safety on the roads. Today, it is raining, so the app tells her that the ground might be wet and slippery, and she needs to pay extra attention to careless drivers who might not be able to see her if it was normal conditions. Additionally roads have less friction which increases chances of hydroplaning. The app also shows warnings of any potential hazards/closed off area which tells her if there might be extra debris on the road or if the road might be closed. This means she might not be able to take that route. The app also informs her of any bike infrastructures that exist and current traffic predictions on the quickest route as if there is a lot of traffic and her route does not have designated bike routes, then she might not be able to ride on that road due to the heavy congestion. If her bike route does have bike lanes then she might need to be mindful of other bikers using the same route. This could also impact her safety because heavier traffic makes it harder to focus on both the road and other drivers, thus making her ability to reach her goal of getting to school slower. After getting this information, she starts the route, and gets on her bike while the interface gives her direction/hazard information and she bikes to her class.

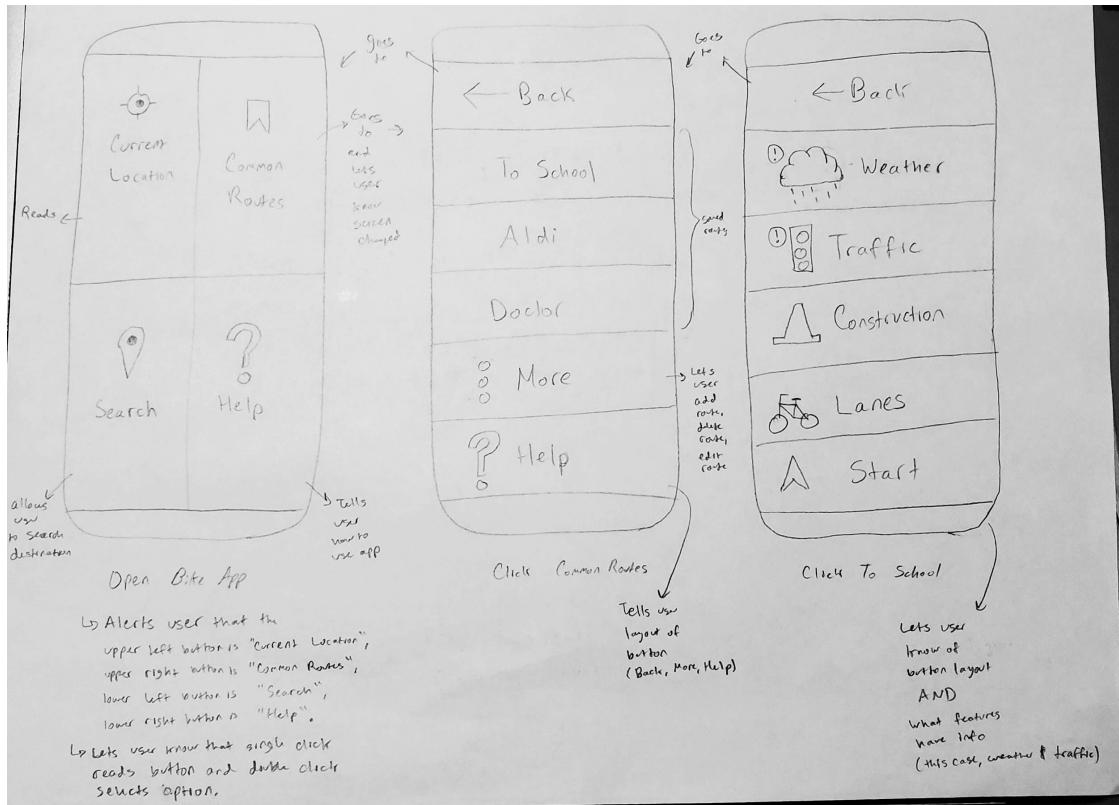
# Individual Design Sketches

## Mike

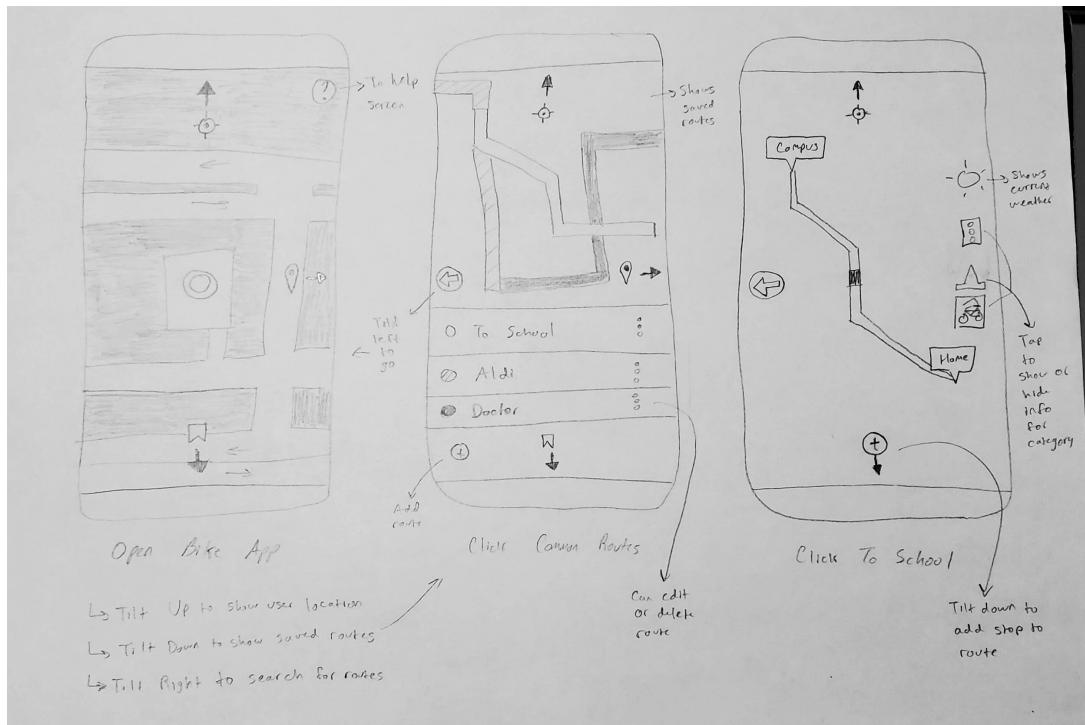
### Design 1 - Illiterate Users Focus



## Design 2 - Blind Users Focus

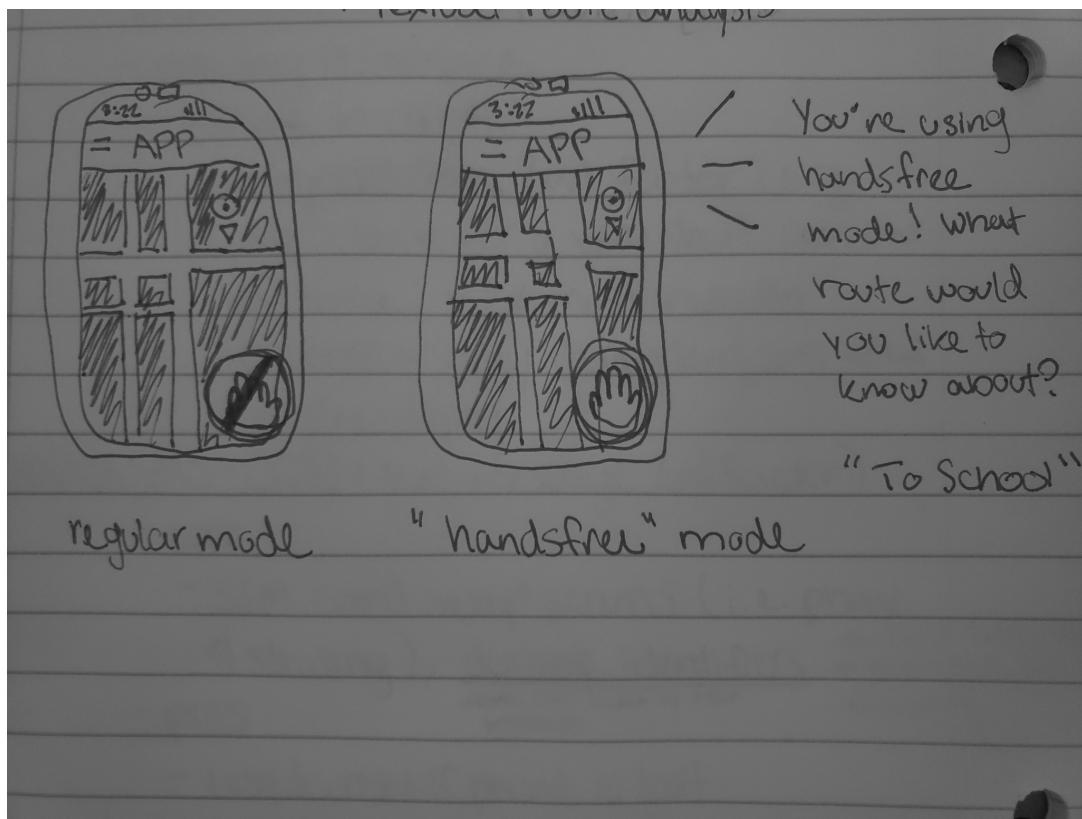


### Design 3 - Using Tilt Sensor



# Kirsten

Design 1 - For Use While Driving



(Additional Notes: direct manipulation map with easy switching between regular and "hands free" mode; "hands free" mode has similar functionality but reads text/warnings/etc. to the user and accepts voice commands; user may still use touch screen but prompts from the app encourage voice commands)

(Sample Interaction When Selecting "Hands Free" on the app home screen)

App: You're using "Hands Free"! What route would you like to know more about your common routes?

User: Yes. Route "To School."

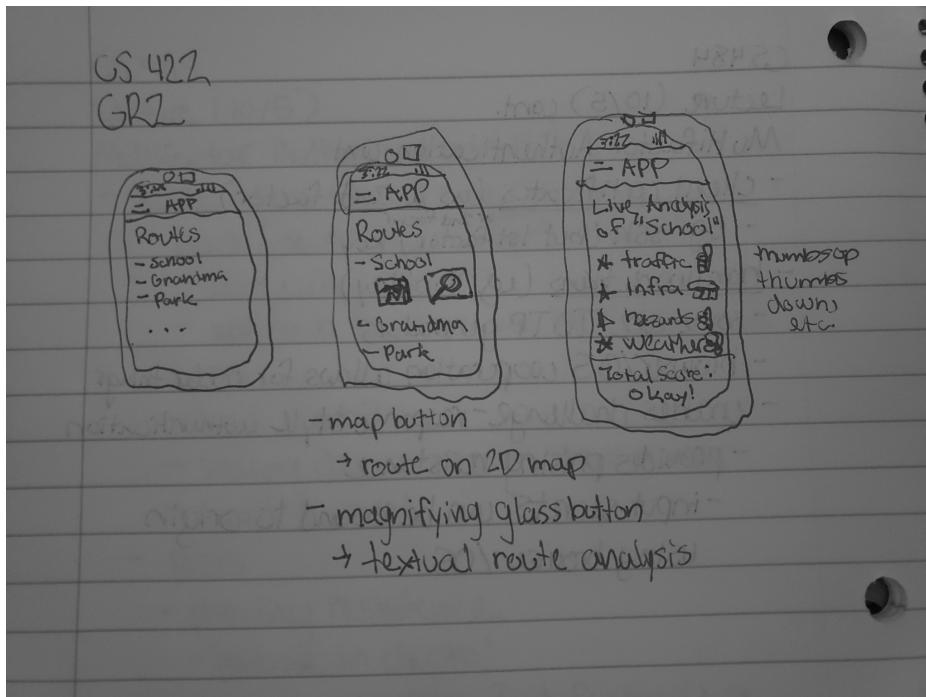
App: Here is the route "To School." There is currently minor construction on this route. There is bike infrastructure available on some of this route. The local weather is 72 degrees, partly cloudy, with a mild chance of rain.

Design 2



(Additional notes: focus on direct manipulation interaction; after route is selected, it is displayed on map; color-coded alert symbols highlight certain kinds of route issues and can be clicked on for more information; a weather overlay can be toggled on and off (button for this is not pictured))

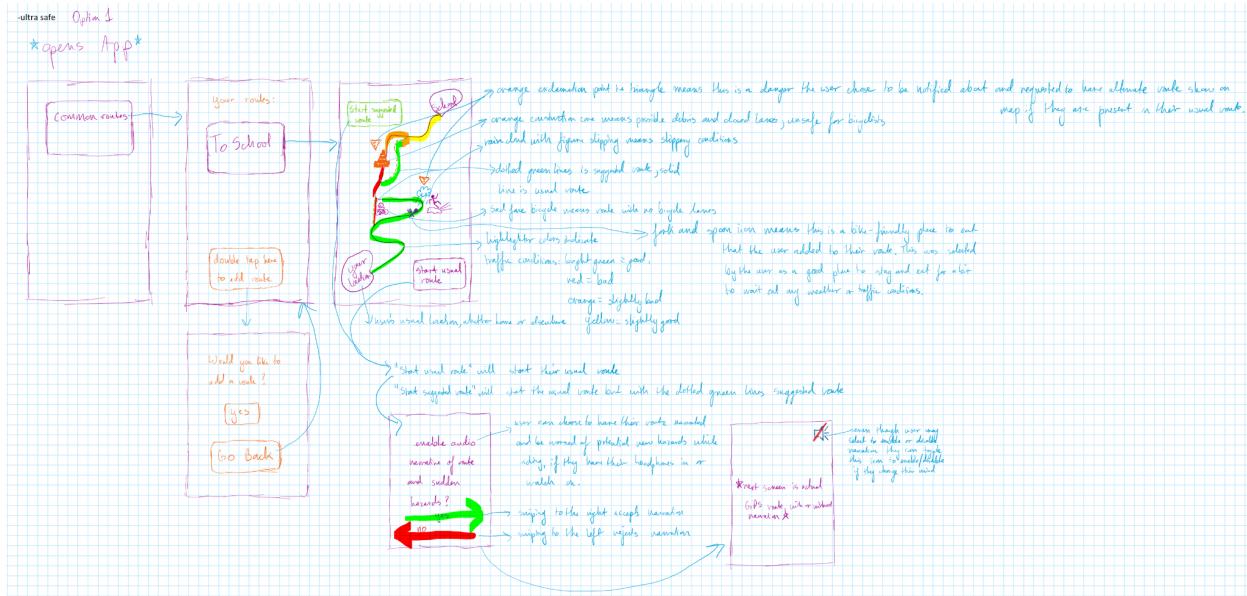
### Design 3



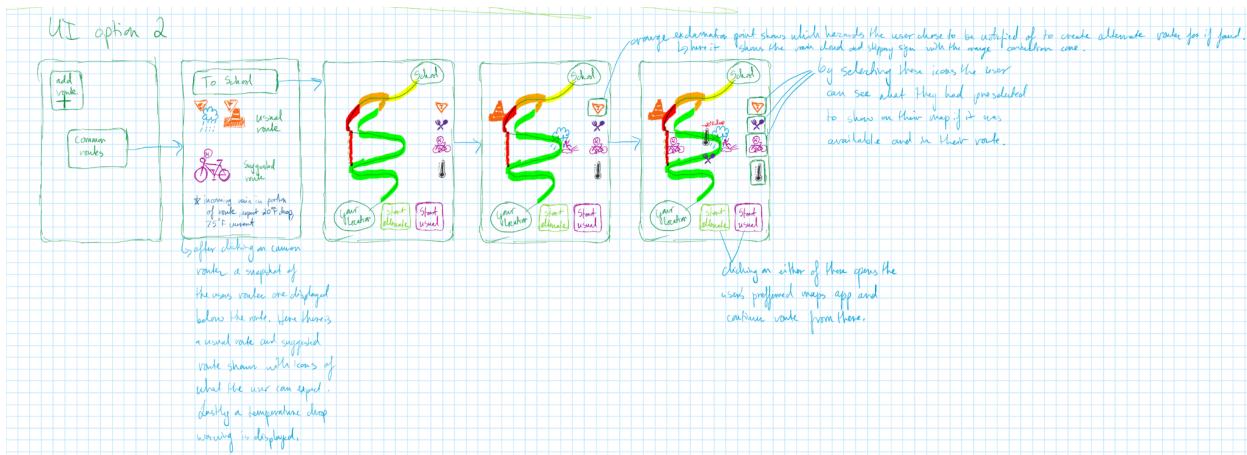
(Additional Notes: focus on menu/list interaction style; double-line symbol next to app title includes sidebar menu with “add route” feature, settings, and help; after a route is selected, a set of buttons appears below the route; users can select the “map” button for a graphical route view or the “magnifying glass” button to get a text summary of the route conditions; color-coded symbols will denote the status of a given condition (e.g. a red “thumbs-down icon” denotes that condition is poor); application may offer to reroute user if overall condition score is low)

# Patrycja

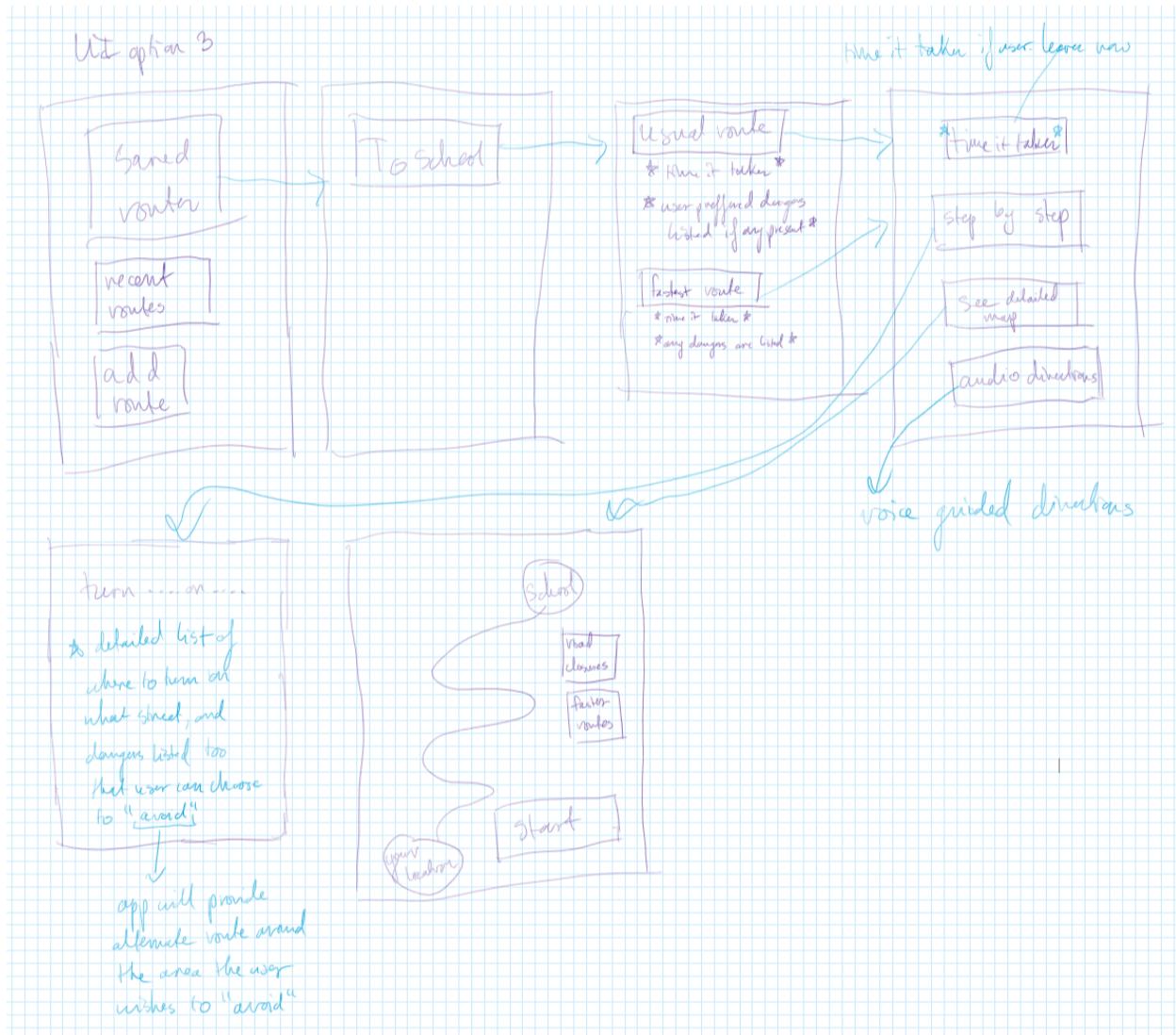
#### *Design 1 - Ultra Safe (preventing all errors)*



## Design 2

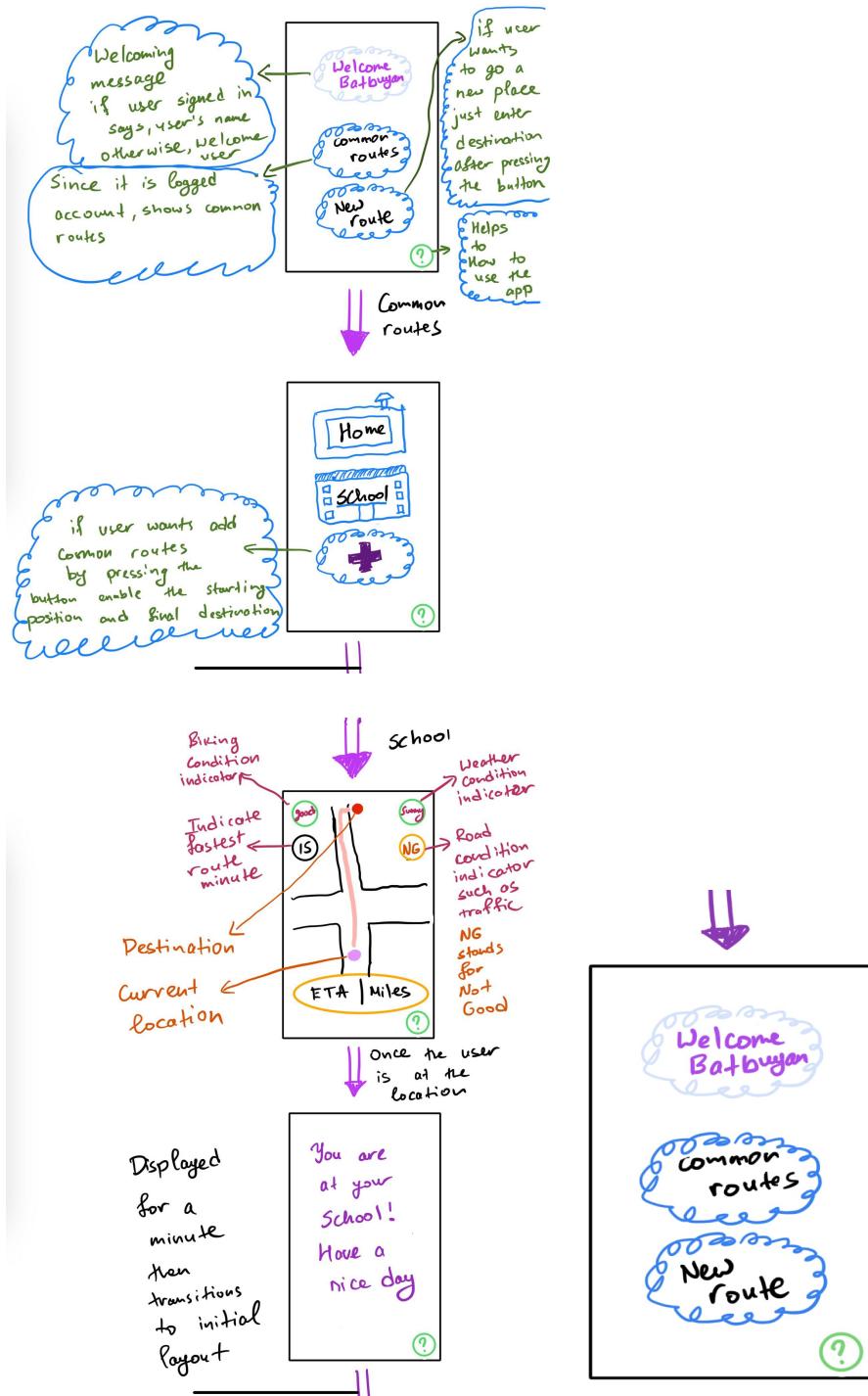


### Design 3

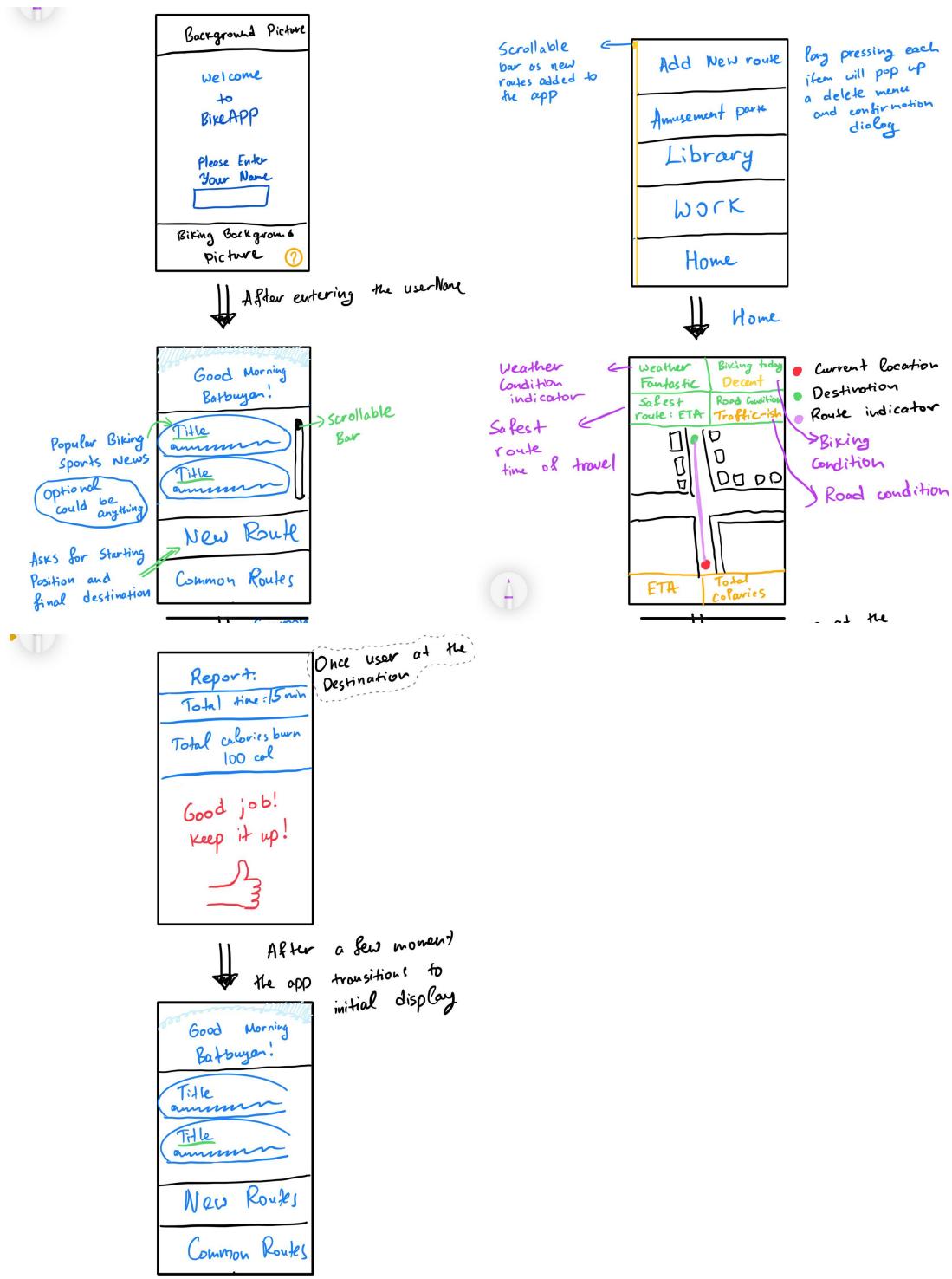


# Batbuyan

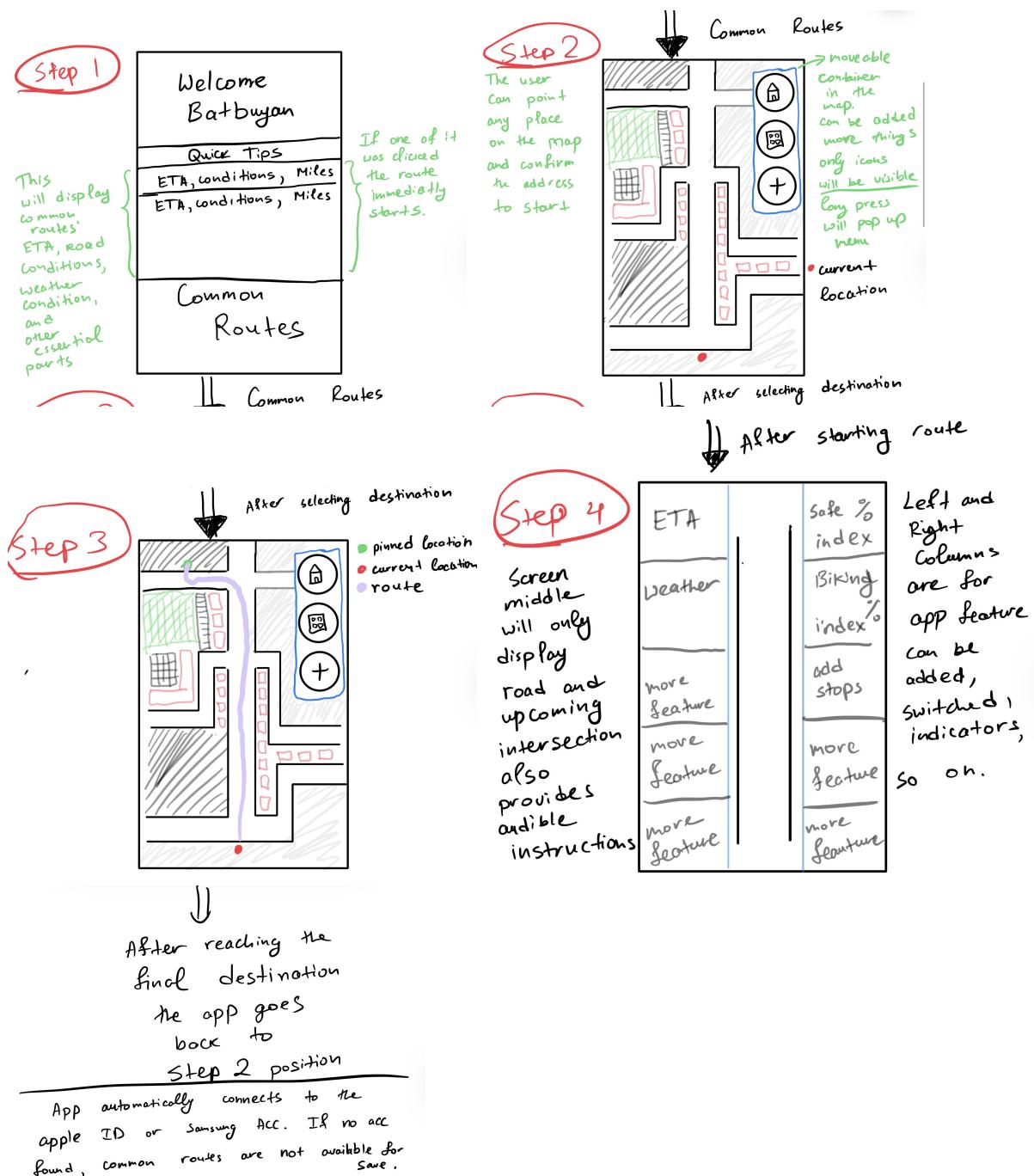
## Design 1 - Children



## Design 2 - Elderly

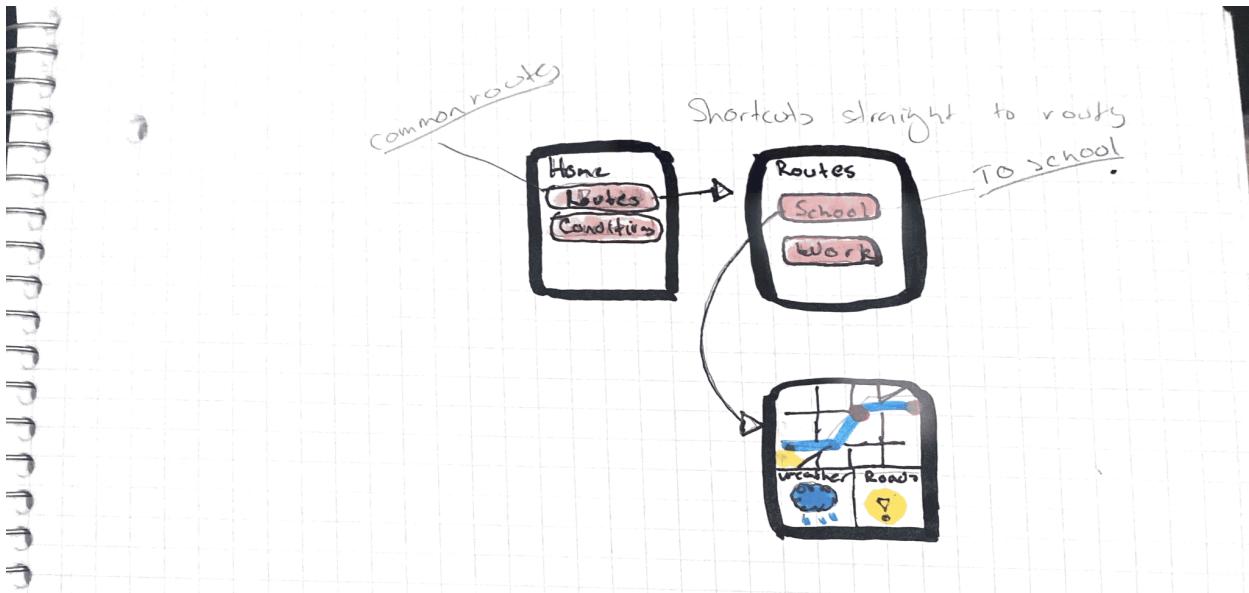


### Design 3 - Ultra efficient

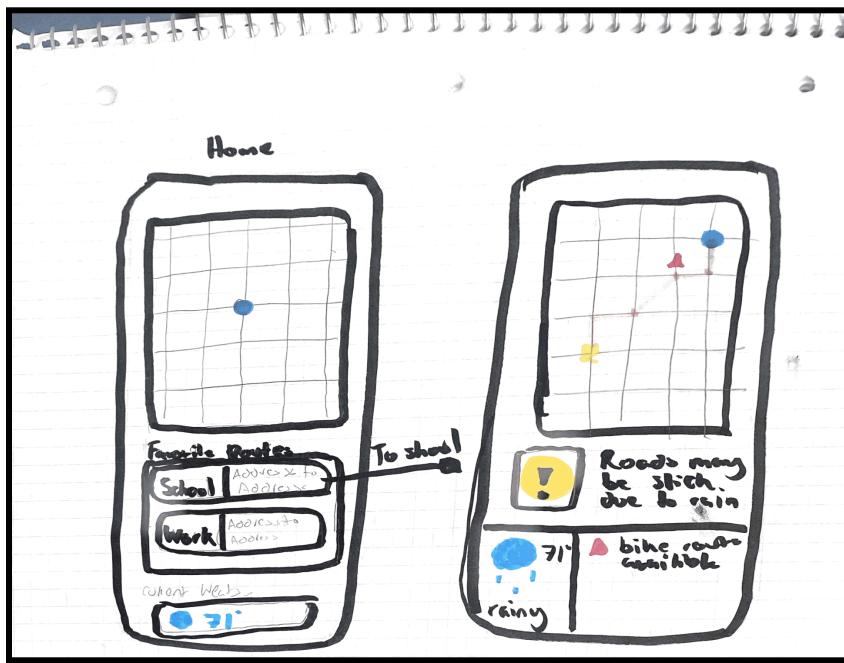


# Angelica

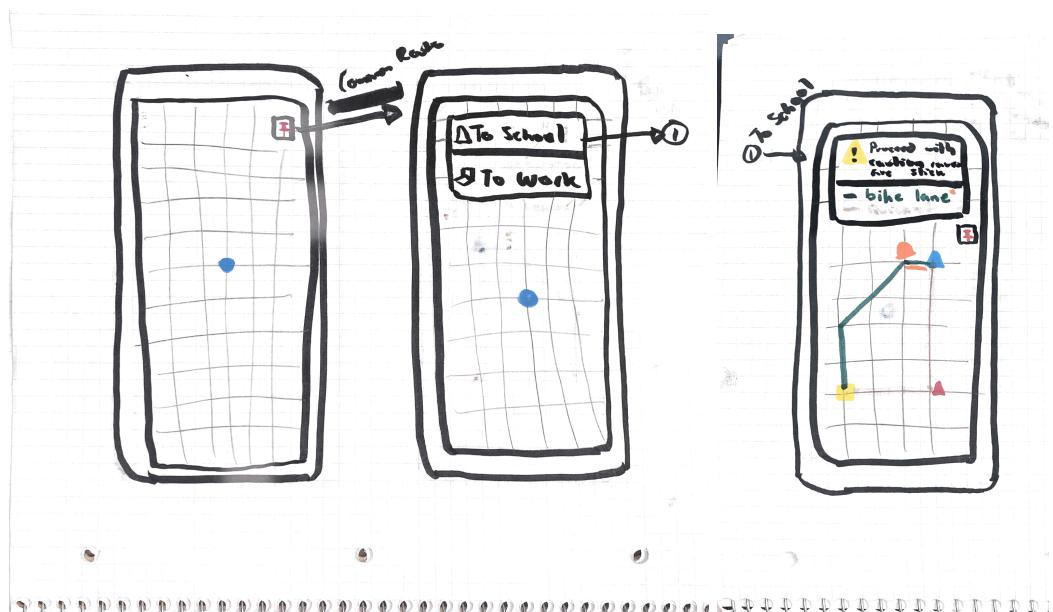
Design 1 - Small Screen (Smartwatch)



Design 2



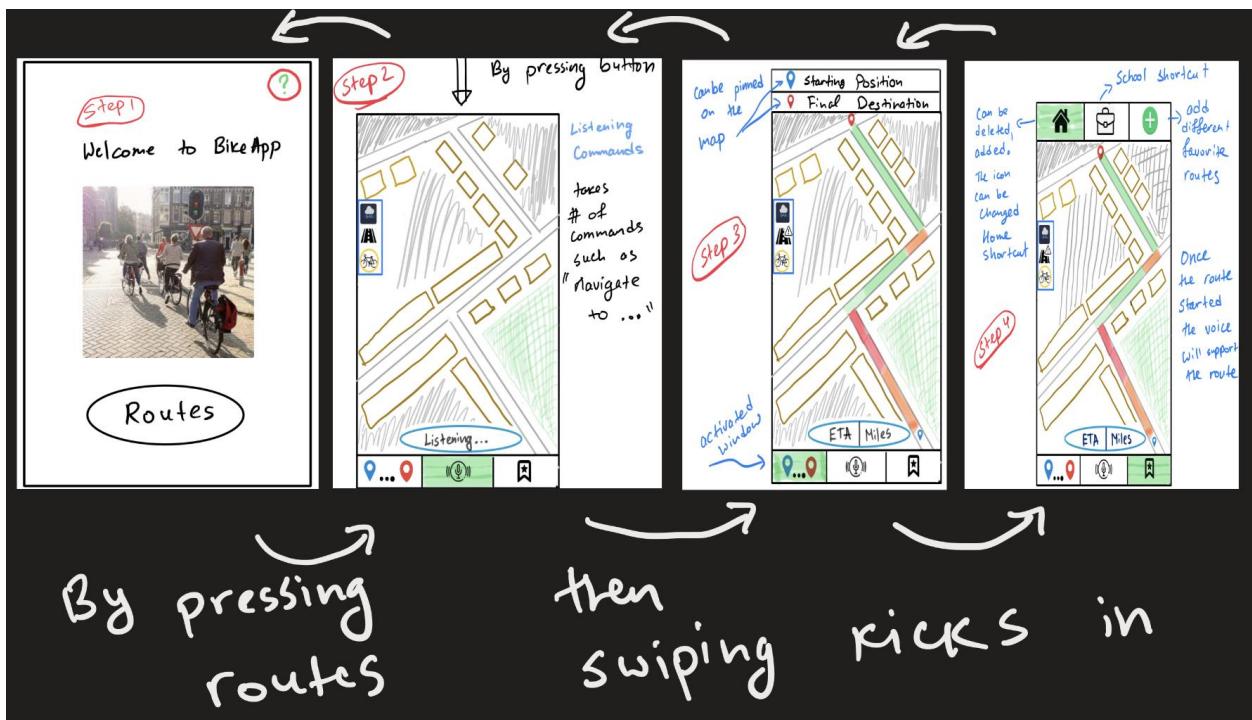
### Design 3



# Group Designs (Storyboards and Analyses)

## #1: Simple / Graphical

Jane wants to go to school, so she opens up the BikeApp; then she presses the “Routes” button which transitions to the big map screen. Then, she presses the “Speak” button and says the command “navigate to school” which immediately changes to the route. The road and weather condition indicators change to reflect the selected route’s condition. (Just for user confirmation, the address shown above. Once the route has started, these will disappear.) Also, Jane can select a favorite route and immediately start the route.



*Note: The bike app will support audible directions once the route has started. The bottom bar also has a menu option which extends to different options. The menu provides the option to make a sound while on route. Swiping functionality is implemented, so if the user wants to go back to the home screen just swipe to the right. Swiping Right to Left also transitions between bar items.*

### Analysis:

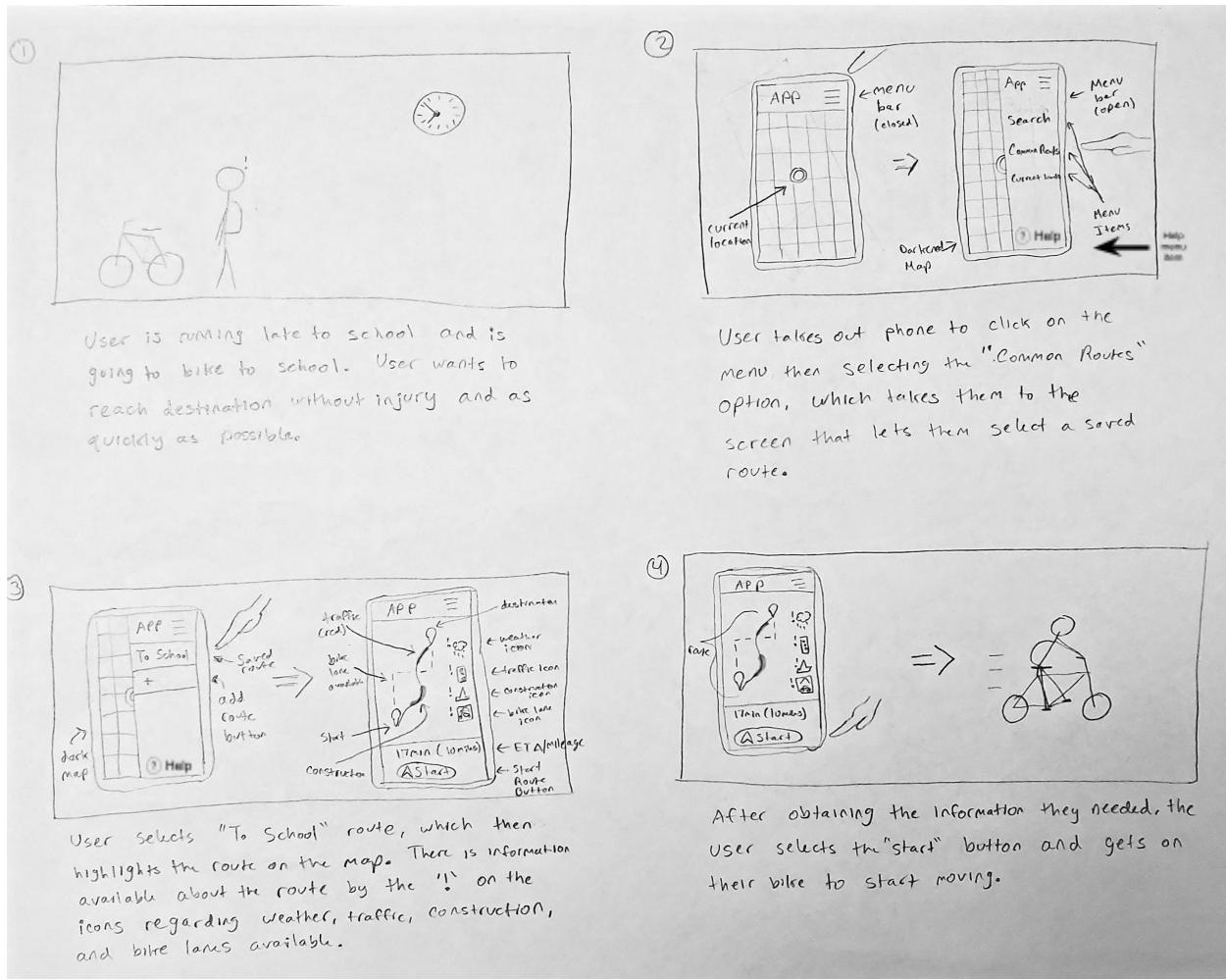
In terms of learnability, the interface has several notable pro-learnability design choices. First, it focuses on a direct manipulation interaction style; features are accessed primarily by labeled buttons. These labeled buttons make use of metaphor to demonstrate what their usage is to users (e.g. the “house” icon starts navigation from current location to home). Additional settings can be accessed via a sidebar menu, which incorporates another interaction style (menus/forms) wherein the interface helps users to remember the available settings. All of these details support user recall over user recognition, making the interface easier to learn. Finally, it is worth noting that the “Speak” button uses a speech dialog interaction style, which does rely

heavily on user recognition to use. However, this feature is not required to use the interface, and it does benefit advanced users in other ways (as discussed further in regards to efficiency).

In terms of safety, the interface inherently needs very little error handling. Since users primarily interact with the interface via direct manipulation, error messages are not needed to provide error feedback. If the user happens to slip and make an incorrect choice (say, selecting the wrong route), such actions are easily correctable by reselecting the same button. Mode errors are a cause for concern, given that this interface effectively has a “speech” mode via the “Speak” button. However, precautions have been taken to avoid such errors by increasing the visibility of “speech” mode and by making it a spring-loaded mode; “speech” mode is initiated by a large button (which is highlighted when active), and the interface displays an additional large “Listening” icon to remind users of its current mode.

In terms of efficiency, the interface design supports efficient usage in multiple ways. Chunking is used for the button displays; on the map screens, buttons related to overall interface navigation are chunked at the top of the interface while buttons related to using and navigating the map or the current route are chunked at the bottom. The buttons for map route conditions are chunked as well on the center-left side of the interface. Some large buttons are used to reduce the distance users must move to physically select their desired target, which increases the speed at which said targets can be selected. Additionally, making use of the “Speak” button can be very efficient for advanced users, given that it allows for “speech dialog” interaction with the interface.

## #2: Minimalist / Catering to More Advanced Users



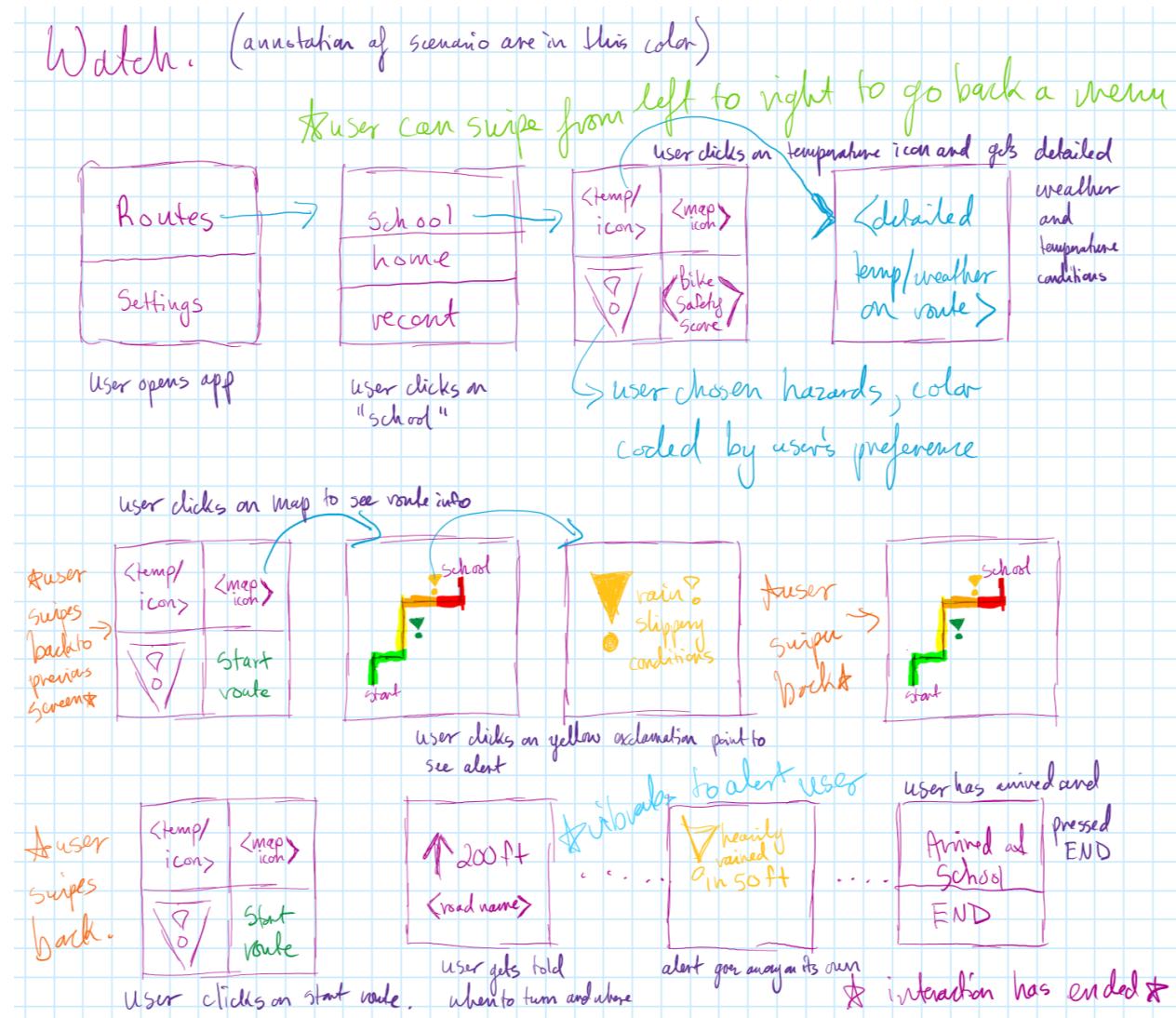
### Analysis:

In terms of learnability, the interfaces have a direct manipulation interaction style as seen through labeled buttons and menu items, as well as having icons in the sides and the highlighted route that have different colors based on certain factors. Whenever a selectable item is clicked, there is an immediate visual change. Along with that, the interfaces have menus and forms, which have all the knowledge in the app. Also, the app uses metaphors (such as a traffic light icon for traffic information). These three points relate to the design recommendation of using recall over recognition to promote learnability. In case if a user gets stuck or confused, there is a help option in the menu, which is goal-oriented.

In terms of safety, every interface besides the home screen has a way to go back to the previous screen by swiping to the right in case an execution error, which encompasses lapses and slips, or planning error (mistake) occurs. Also to prevent mistakes, saved routes are editable. To prevent a description error, all icons and colored parts of the route are different in terms of shape and color(s).

In terms of efficiency, the interfaces support chunking. In the opening screen there are only two chunks; the top menu and bottom map. When the menu is open, the left chunk is the map and the right chunk is the menu, which has chunks themselves as seen by the different options, which have a maximum of five items. When a route is selected, there are four chunks: the top menu, the side icons, the route, and the bottom bar, which have two chunks within it: the ETA/mileage and start button. These interfaces also decrease the time it takes to move one's hand from one point to a target by having large targets (that is the buttons, icons, and menu items) and having the icons and menu targets at the edge of the screen, which makes their size infinite. Both of these make the target size larger, which relates to the principle of Fitts' Law.

### #3: Smartwatch



Note: On the watch interface the app vibrates to let the user know they are approaching an area they designated to be informed about, in this case an area that has heavy rain so conditions are slippery.

### Analysis:

In terms of learnability one area that this design is successful in is that it has familiarity in terms of using currently existing gestures such as swiping to go back a menu. Additionally, it uses common icons to display items such as using color coded exclamation points which users can customize themselves depending on what alerts they are looking for, such as bike lanes, weather changes, or construction zones. Additionally, menu items use familiar icons, such as maps to lead to the map section, where they see the familiar green-yellow-orange-red traffic color coding over their route. Some ways this design is not successful in terms of learnability is

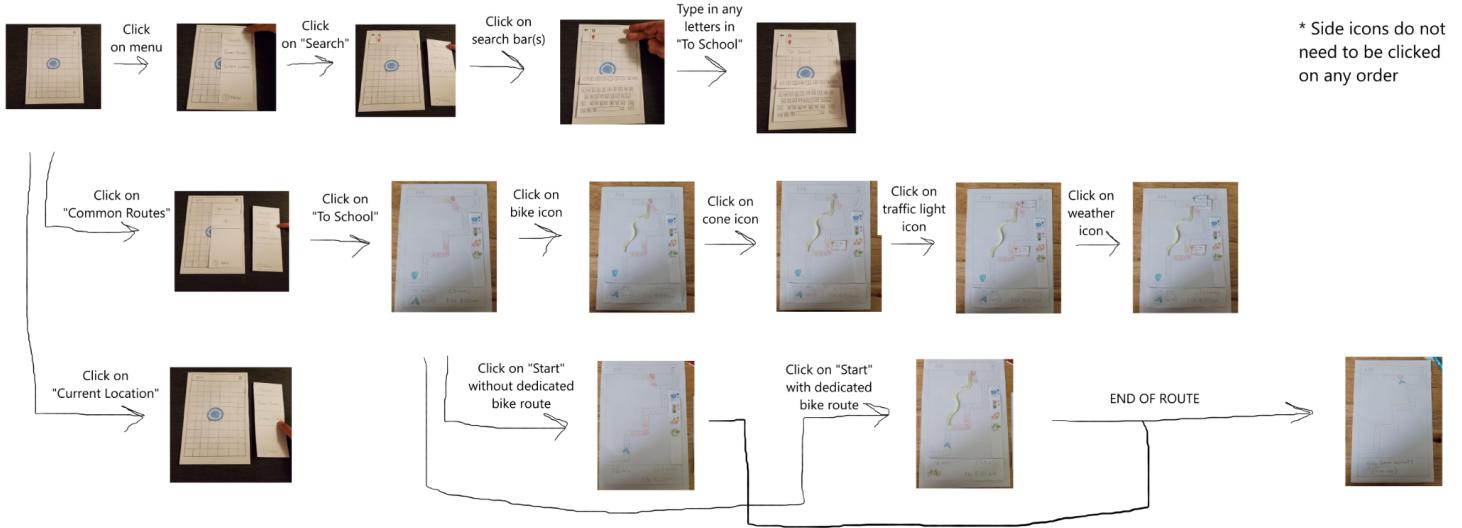
that it requires recall of past settings or any past routes that have been set up. So if you move, or if you haven't looked in a while, you may have to figure out where each route leads rather than recognize it via text/imagery.

In terms of safety, the interface eliminates any modes as the screen is small, and the main user input are buttons which extend to the edges of the screen. Additionally, if the user were to make a mistake and enter the incorrect page, they can easily reverse by swiping back to get to the screen they were last on. However, as the watch is a small screen it is easy for the user to slip and click something they were not intending to click.

In terms of efficiency, this interface utilizes chunking by putting common things together. For example, all routes are placed together so it is efficient for the user to navigate through all the routes, rather than searching for different categories. Additionally, the buttons on the home page, the routes menu, and the main route screen utilizes edges and corners to make the target easier to hit. One of the failures in efficiency is due to the fact that a watch has limited screen space, thus a user needs a phone to connect to see recent routes or to add a route. Finally, there are minimal shortcuts on the interface due to the size of the interface, thus everything is kept simple. However, this lack of shortcuts does reduce efficiency.

# GR 3: Paper Prototyping

## Initial Prototype Images



## Briefing

Hello! Thank you for deciding to take the time to help us test our application. My name is \_\_\_\_\_, and we are students at UIC. The goal of our user testing today is we want to increase our understanding of how users navigate through our biking application. Since we are the creators of this app we can't see any of the flaws in it, so we need your help to be able to understand if there is anything weird about that we haven't caught yet. This will take anywhere from 15 to 40 minutes. We will give you four tasks to complete through this testing, and they will be presented to you one at a time. While navigating these tasks, please speak out your thought process, such as why are you clicking on something, what are you thinking, what do you see, what are you looking for, or if anything looks weird or unusual. These tests are about our application and we would really appreciate your any honest feedback, comments, or suggestions you might have, so please feel free to speak out loud with no filter. So, the premise is that you frequently commute on your bike. You have already added routes to your app prior to today, so now you are in a rush and have to pull up your route to check it.

## Scenario Tasks

1. Find the route: "To School".
2. Check for any road condition concerns along the "To School" route.
3. Check the weather information on the "To School" route.
4. Start your route (bike lane or not)

# **Observations**

We ended up doing two rounds of testing. Our first round consisted of three different users and our second round consisted of four different users. No person was tested more than once.

## **Observation Field Notes:**

### **Round 1:**

#### **User 1:**

- clicked through the buttons seamlessly
- for first task, they chose the “Common Routes” button over the “Search” button
- in the third task, there was a lot of clicking to figure out what to do; they didn’t assume they could click on some items
- asked a lot of questions about the buttons

#### **User 2:**

- understood the first menu options
- understood our intention for the bike path
- for the first task, they chose the “Common Routes” button over the “Search” button
- asked about consistent design (location icon was not consistent between screens)
- some confusion on where able to click

#### **User 3:**

- confusion about the location icon (wasn’t sure what it meant)
- for the first task, they chose the “Common Routes” button over the “Search” button
- first task went pretty quickly
- confusion about weather icon (wasn’t sure where it applied to)
- some questions about the areas (of the things that pop up) (e.g. “Is the popup clickable?”)
- confusion about the traffic light meaning (until they clicked on it)

### **Round 2:**

#### **User 1:**

- for the first task, searched using the bottom search bar (some confusion about search fields)
- thought that pop-up notifications were buttons
- unsure about what street light meant
- liked the bike lanes option (but confused about different options)
- thought it was weird to have the main road route still showing after bike lane reroute
- Don’t want to have too much. What if you’re really lazy ?

#### **User 2:**

- for the first task, used hamburger menu to access “Common Routes” submenu
- wondered at the significance of the exclamation marks on the route screen sidebar icons
- user thought traffic cone icon for “Traffic” pop-ups was a hill
- this user was color blind and noted that they could not distinguish between traffic light colors, etc.
- wasn’t able to find the exact time of route right away (then found it)
- sees the color changes rather than buttons
- tried to click the pop ups
- tried to click on the highlighted parts of the road
- assumptions of the route colors of traffic
- uneven roads, nice to know
- confusion on the bike lane a bit; wants to take bike lanes.

User 3:

- for the first task, used hamburger menu to access “Common Routes” submenu
- user also thought traffic cone icon for “Traffic” pop-ups was a hill (suggested adding stripes to icon to distinguish)
- questioned whether they would need to see weather-related pop-up alerts if weather conditions are supposed to occur after estimated arrival time
- noted that route start time isn’t visible
- doesn’t know what to press for options
- road condition concerns (guessing orange and red is traffic)
- assumed done early with the third task (poorly worded?)
- felt that route sidebar icons were grouped oddly; noted that the “Bike Route” button acts differently than the other icons and not in the way that they expected to
  - suggested that said button be moved elsewhere or that its functionality be changed
- noted that his approach to bike routing is shaped strongly by Google Maps mixed modes
- noted that it was not obvious how to bike
- noted that there was no obvious way to cancel a selected route
- noted that route was not highlighted
- thought that white spacing on bottom-left of ETA pane looked awkward
- thought that hamburger menu would be more natural on the top left of the screen
- felt that side menu should be somewhere else
- Wanted there to be an indication of which route condition buttons were pressed

User 4:

- for the first task, searched using the bottom search bar (some confusion about search fields) (aliasing, hyperlink, dns concerns)
- like previous users, confused about what area of the map the weather pop-ups apply to
- like previous users, assumes the cone icon depicts a hill
- confusion about road conditions versus traffic (task wording?)
- felt that the hamburger menu was an odd place for the common routes to be listed (user associates those menus with having app settings, help, etc.)

- icons are fine but pop out on left versus right?
- assume it is like a pull out rather than pop up
- would be interested in having the overlay all the time (including while bike)
  - since it disappears when navigation starts, how would they know if road conditions change?
- drawn to the highlights
- felt interface similar to Google Maps or Waze

## Analysis After Observations

From our testing there was some general confusion on the side bar icons meanings/popups. Particularly, the stop light and the cone caused confusion regarding their respective meanings/what they were meant to represent. This was a problem in learnability as the metaphors were not understood as intended.

Additionally, uncombining the bike lane button from sidebar icons, as it feels out of place to have bike/route content with safety information such as weather condition, road condition, and traffic. These issues are related to chunking in learnability.

Clicking the side buttons takes time. Should the user want to minimize clicks, then having all the options on the side might not be the most efficient/effective option. In other words, having redundant information triggers efficiency problems.

Finally, a user who was colorblind showed us some faults in our use of color (particularly orange) to represent items. Additionally, people already have assumptions of route colors (red and orange indicate differing intensity in traffic concerns). This illustrates that we have accessibility issues in our application.

Some complaints on where the hamburger menu (three bars stacked vertically) is located and how the content pops out.

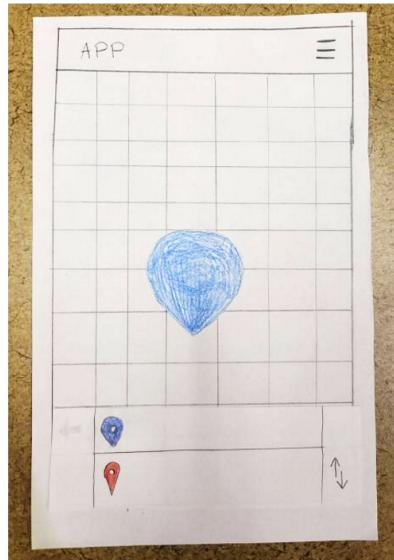
Another problem was with the value and hue of the route's highlights; Some people wished for the selected route to be more clearly highlighted.

As users were expecting our map to have all the features present in Google Maps. So, users were expecting our interface to have multiple features as seen in Google Maps.

## Prototype Iteration

We ended up doing two rounds of testing, this led to one additional iteration of our application. Our first round consisted of three different users and our second round consisted of four different users. No person was tested more than once.

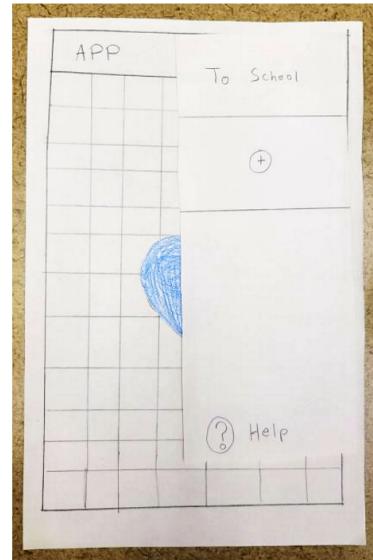
## Images



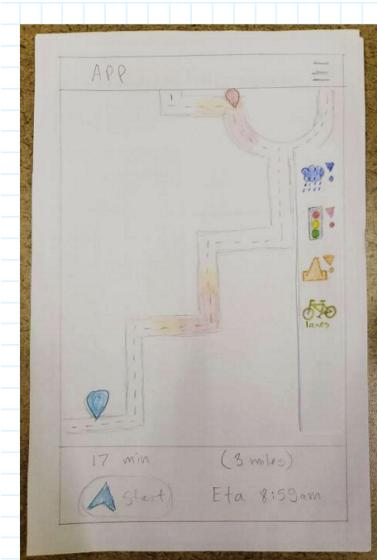
user opens App



user clicks on red field  
to type in route; it autofs  
as soon as they start typing



user clicks on  
hamburger menu



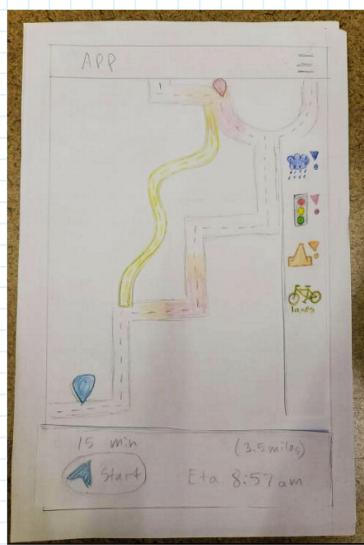
after user clicks on  
"To school" (hamburger or search)



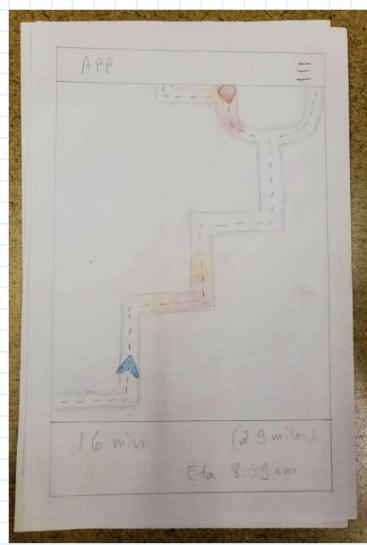
User clicks on raincloud  
to check weather



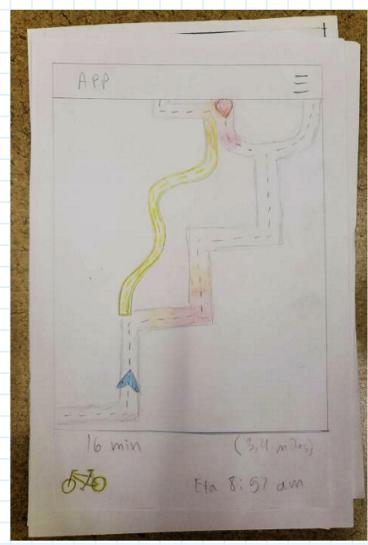
User clicks on traffic light and  
construction cone



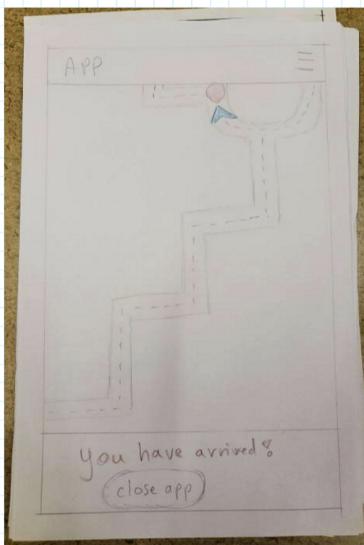
user clicks on bike lanes icon



user clicks "start" without bike lanes



User clicks "start" with bike lanes



User finished route.

## Outcome of Iterations:

After our first round, the users found it difficult to understand the pop-ups regarding what they can do (i.e. Can they be clicked? Dragged?) and their significance (i.e. Is it for this section of the route? The whole route?). We decided to make it more clear by making our model a more distinctive shape.

The second change was made with the search bar. Originally, we had two menus upon clicking the top hamburger menu. It was decided, based on some feedback, that the extra menu just wasted some time and added some confusion because it felt unnecessary. We decided to remove the initial menu screen and replace it with the menu screen that contained the already defined routes. Also, the search bar was changed to automatically be present at the bottom of the screen, rather than be an option that the user selects. These changes helped decrease the layers and amounts of chunks from the menu and routes thus increasing efficiency.

A third change was made to some items to increase consistency. Rather than having a circle show the user's location, it was changed to more of a location pin shape. In some of our testing sessions, the users assumed that the circle was a button, so changing the shape was meant to see if this would reduce confusion. This was a problem with learnability as people had the assumption that a circle should be clicked.

# GR 4: Computer Prototyping

## Platform Details

This prototype was created using Figma; as such, it is compatible with multiple platforms (both web and mobile browsers) and operating systems. Figma's minimum browser/operating system requirements can be viewed in detail [here](#).

## Usage Instructions

1. Go to  
[https://www.figma.com/file/kzqNTx55XINGaFzUqlajT/CS422\\_GR4?node-id=0%3A1](https://www.figma.com/file/kzqNTx55XINGaFzUqlajT/CS422_GR4?node-id=0%3A1)
2. Click on the “present” icon  in the top right corner of the screen.
3. You may now interact with the prototype within the phone’s boundaries.

## Peer Feedback Incorporated

1. It was mentioned by several of our peers that the chunking of the icons are confusing with the bicycle, therefore users could not tell what the bicycle did. A couple other reviews mentioned putting the icons on the map instead of having a sidebar. We incorporated these two things into one and put the icons on the map.
2. Color blindness was mentioned in the peer reviews, and we also encountered this in our user testing. We decided to fix this issue by creating better icons in terms of shape and not color. We got rid of the construction cone and made it more clear by adding a text to the icon, and recognizable construction icon in terms of shape and not color.
3. Another concern in the reviews was how does the user know if they are looking at a bike specific route or not. We have fixed this by making a clear button which can be toggled on and off, changing color to look green or shadowed out and words saying on/off, to make it clear which route the user is looking at.

## Shallow Parts

The shallow components are as follows:

- In the hamburger menu containing saved routes, additional routes cannot be added with the “+” button.
- The map is not currently scrollable.
- The keyboard buttons are not implemented; if pressed, it is assumed that the user would enter the destination address that corresponds to what is saved in the “To School” route.
- If the “End” button is pressed at any time during navigation, the scenario will be completed/reset. (If actually implemented, this button would return to the home screen and would reflect the user’s new location).

- The three dot ellipsis on the “To School” route is not implemented for the scenario, but if it was it would allow the user to edit this route. Editing options would be renaming the route and changing the route destination.
- Furthermore, three dots everywhere in the prototype does not work. We have not implemented it yet. Since we are unsure about what other features can be added.

# GR 5: UI Development

## Link to Project

Website (open the link below to see the app in browser)

<https://angelica-v.github.io/cs422-bikeApp/index.html>

Link to the GitHub Repository (Code)

<https://github.com/angelica-v/cs422-bikeApp.git>

## Project Instructions / Browser Expectations

The deployed [prototype](#) can be accessed from the website link above.

To open the app and interact with it seamlessly, please open the “[Website](#)” link above in your normal browser (Chrome, FireFox, Safari).

## Shallow Parts

- Magnifying glass is there to represent searching capability, but it is not implemented.
- “Add Route” goes to a page where the user can theoretically add a route, but this is only a shallow implementation. Actually clicking on “Add Route” does not actually add the route to the UI.
- “Edit Route” is only a shallow implementation as well. Clicking on “Confirm Edits” or “Delete Route” does not actually affect the UI.
- When you “Start” the route it does not actually start a GPS that tracks your location. We implemented a 5 second timer to get to the “Arrived” screen.

## Future Implementations

- Adding a watch that makes noise/vibrations notifications and displays colors depending on the hazards.
- Have the route marker track through the route and track in real time.

## Work Distribution (for GR5)

### Angelica

- Worked on setting up pages, and Map API, including all pop-ups/information, routes, and views.
- Added the edit route and add route pages.
- Added core of the hamburger menu and style elements
- Made sure that style was consistent throughout the pages.
- Worked on the feedback spreadsheet.

### Mike

- Created the navigation screens after clicking “Start” on the route “To School.”
- Connected the navigation screens upon clicking the “Bike Mode” button no matter the screen user is in.
- Fixed the screen the user goes to upon clicking the “To School” route.
- Fixed the background of the back icon image.
- Created an arrow icon for navigation.
- Fixed the formatting of the bottom bar in all the “To School” route screens.

### Batbuyan

- Added a back button with an icon.
- Added a few icon images.
- Made the browser installable on a mobile device.
- Worked on the feedback spreadsheet.

### Patrycja

- Added “Bike App” title to home page.
- Replaced the hamburger menu with “Routes.”
- Added magnifying glass (search icon) to bottom right of home screen.
- Worked through addressing the feedback that was received, what was incorporated and what we did not incorporate and why.

### Kirsten

- Created route start/end bar template.
- Wrote route ending screens for both versions of To School route (bike mode ON/OFF).
- Added a new banner element to notify users about destination arrival.

## Addressing Feedback

 Bike App Feedback

# GR 6: User Testing

## Design

### Design Decisions

#### Efficiency

Shortcuts:

To increase efficiency we added effective shortcuts to routes. The user is able to edit and add routes to this list. We decided to add this interface as this allows users to quickly navigate to common routes they may use thus reducing the need to search consistently and increasing efficiency. These shortcuts are found in the hamburger "Routes" menu (Figure 1). An example is the "To School" route (Figure 2). We also decided to add to this menu the options to either add or edit routes based on the heuristic feedback we received.



Figure 1: Routes Button

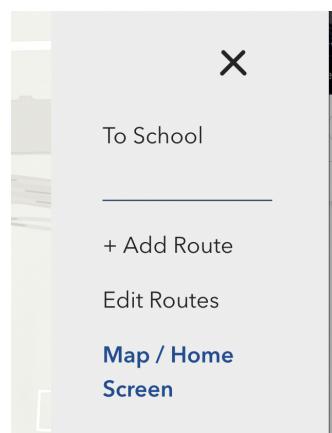


Figure 2: Open Routes Menu

## Chunking

In our Routes Menu (Figure 2) we chunked all route information together. Additionally, in this chunk, we split it into two areas, separated by a line, customizable routes, such as “To School” on the top, and route functions such as Add and Edit Routes.

## Learnability

### Metaphors

We used metaphors to increase learnability and to allow users to find the information they are interested in quickly. The most notable place we did that is in our popups. In one of our original paper designs, we found our original metaphors were vague (a traffic cone looked a little too much like a hill) so we changed the construction metaphor we used. In the next evolution, our web-based prototype, there was an exclamation point next to each warning. However, through our heuristic evaluations, we found this to be unnecessary and confusing to users so we removed this and found an increased recognition of these newer icons (Figure 3)



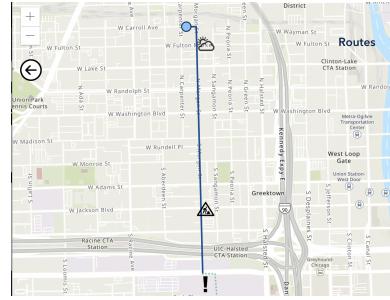
Figure 3: Icons used in our final design

### Recognition versus Recall

In our application, we used a map API that had similar functionality to other maps that users frequently used such as Google Maps (Figure 5). Users are able to zoom in and out of their location (Figure 4) and scroll around the map, rather than it being a static image as some of our earlier designs were.



Figure 4: Zoom in and Zoom out



*Figure 5: View of Map API*

# Safety

## Back Button on Route Screen

After feedback on our heuristic evaluations, we made sure to add a back button to our maps page. This allows users who have a slip or error of clicking on the start prematurely or who click on the wrong route to navigate to the page they were originally on. This prevents any major errors that would require the user to restart the process and prevents users from being stuck on a screen until they finish or end the route.



Figure 6: Back Button

## Menu Highlighting

To prevent slips and provide awareness of where the user is, in our Routes menu the current page a user is on is slightly bolded and changed to blue. This allows the user to notice a mistake they may have made, ensure they are in the correct location and know if they need to switch (Figure 7)

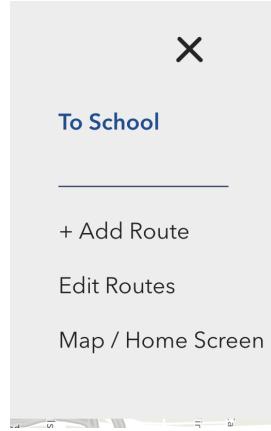


Figure 7: To School highlighted in the menu

## Other

### Consistent Graphic Design

Through our pages, we ensured that the graphic design remained consistent throughout by making sure buttons had similar styles and our start route, route in progress, and end route pages followed the same design principals so users wouldn't misunderstand buttons, and to increase the overall aesthetics of the page (Figure 8).

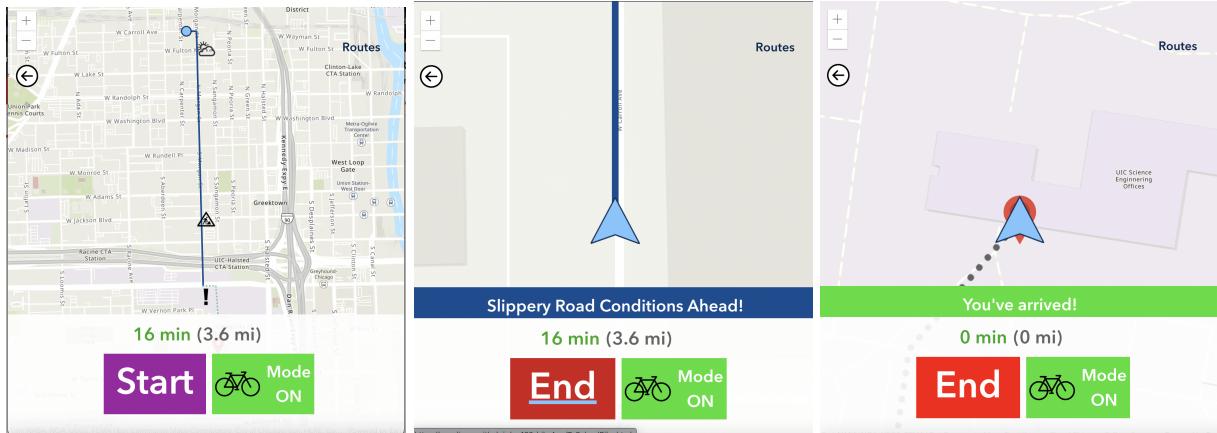
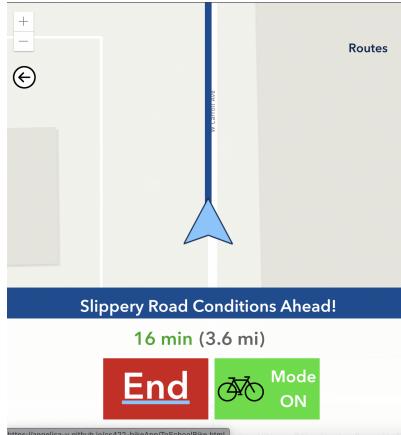


Figure 8: Start Route, Route In Progress, and End Route screens

### Warning Notification

We decided to add road notifications onto the route in progress screen (Figure 9) To add to this, the ideal would be to have a watch implementation that shows the color and warning type as the user approaches to prevent the user from using their phone.



*Figure 9: Route In Progress // Route just started*

## Design Alternatives

- Use of an app bar instead of a single title in the top left and a single button in the top right for the user to find their routes. We ultimately decided not to use an app bar because we got feedback about it taking up too much vertical space on the map, so we decided to remove it for our final product. We did have an app bar for our paper prototype and in our shallow implementation, and during our paper prototype testing our users had no problem finding their routes. This was possibly due to the familiarity that users have with finding the things they need in the overflow area of the app bar. When we removed the app bar and just had the menu button in our final implementation, our users had a hard time finding that button, even though it said “routes.” We are not sure why this happened exactly, because it is in the same spot that we previously tested, but we guess it was too different and too small for the user to be able to find it right away.
- We played with using different colors and shapes for the icons on the route. We originally had different colors and different shapes, but after our paper prototype testing, we decided to just have different shapes and consistent colors for all of them to chunk them together easier. One of our users was colorblind and did not associate the color orange with a construction cone, instead, it looked green to them and they thought it was a hill. After our final user testing, it became clear that our idea of chunking them together was different than the user’s expectation. A different design decision that we considered about this is making them all a different color after all so we can flash these colors on a watch implementation if the user is at the point where that alert is on their route. This would increase efficiency and safety by preventing the user from having to stop their bicycle to read text, instead, they would just see the color on their watch.
- After our final user testing, one of our users suggested that it would be easier for them to have the alerts listed on the upper right corner of the screen, and then they would click the alert from that list and it would take them to the part in their route that has this alert. We had initially thought about doing something like this, and having some type of list of icons or small text alerts on the screen so the user does not have to click on each icon to read the alert. We did not go with an implementation like this because of the variation in

the phone screen sizes that users might have. Some users might have very small screens and an implementation like that might actually take up more than half the screen, thus blocking the map and frustrating the user. We wanted to make sure that none of our users would be frustrated with too much information on the screen, therefore we designed minimally with the notion that the user would expand things if they needed more info.

## Changes After User Testing

After testing our users we found some key areas we would like to change:

### Altering Pop-Ups

Adding more contrast, and fixing API functions.

- After paper prototyping, we made all the icons a consistent color and icon theme so they are chunked better.
- After heuristic evals, we got rid of the extra exclamation points next to the icons.
- After our last prototyping, we would make the icons a lot bolder and possibly different colors. They were not big enough and different enough from the map background to be noticeable to the user.

### Changing the route function

Allows users to alter their routes and allow for flexibility.

- After paper prototyping, we made it clear if the bike mode was on or off, as well as the bike-specific route.
- After heuristic evals, we made changes to display the bike route vs the non-bike route better by displaying a dotted green line to denote the bike-specific part.
- After our last round of testing, we realized our users want to have the choice to be offered a different route if the hazard on their route is something they want to or may need to avoid. This is an implementation we would like to add, to give users the choice to reroute if they want to avoid the hazard on their route.

### Increasing button sizes (Routes, Pop-Ups) & Changing Design

Changing how users view the pop-ups:

- After paper prototyping, we found some of our metaphors were unclear to users, and some of the color usages confused users.
- After heuristic evaluations, we found that having two icons overcomplicated the meaning that users associated with the pop-ups.
- After our last round of testing due to the API adjusting some of the pop-ups, the size of the graphics can look smaller on some screens. We would increase the size of these buttons as well as the routes buttons to give users a bigger target to hit. Additionally, for the pop-up icons, we would want to make the icons bigger and more noticeable as through our user testing we found that some users missed the exclamation mark as it was black, and as our map was primarily monochrome it blended in.

## Push Notifications // Watch Versions

- After heuristic evaluations, we found users wanted to have more route information on the phone, thus we added a banner with the hazard in the route.
- After our last round of testing, we would like to add a bike version of our application and enable push notifications. This way any upcoming warning can be associated with a sound, vibration, or color. This change was based on feedback from users that they rarely look at their phones on their routes. Users primarily look at their phone at the beginning of the trip or if they are lost, as looking at the phone while biking is particularly risky. Having a watch implementation and other ways to notify users is beneficial for getting information while en route as road conditions could change at any moment.

## Clear up Bike Mode definition

- After our paper prototype, we found that using red/orange on the route lead to users automatically assuming it meant traffic. However, as the path was highlighted this was seen pretty clearly as a separate bike route
- After our heuristic evaluation, there was some confusion on how the bike mode changed the route as the bike route was only a tiny section of the screen. Through this, we tried to make it more noticeable by changing colors a bit and making the bike section longer (and allowing users to zoom in).
- After our last round of user testing we found there was some mild confusion on what exactly bike mode meant among the users we tested. Something to implement is to add a help section or legend to our application and make the differentiators between the modes more different by highlighting them and changing the style so the colors are different and so the dotted path is more noticeable.

## Limitations

- By getting rid of the app bar and just having a clickable “routes” button our users had a hard time finding their routes. They kept trying to click on the search icon, which was not part of our scenario as our user would be just finding their saved route by clicking on it.
- By putting the icons on the map and making them all the same color and theme they blended too well into the map background. In the browser, there was some strange behavior that we did not expect, the most important of which was that everything appeared a lot smaller than we coded the app. As a result, it was harder for our users to distinguish what was clickable.

## Evaluation

### User Selection

Our users selected for testing are described as follows:

“Alex” is a biker who travels short and really long distances. They usually have the route ready in Google Maps, look at it before traveling, and put their phone away, only looking when

they become lost. They usually bike to places such as school, work, and home. They tend to stick to routes they are familiar with but are open to changes depending on conditions.

“Sam” is a casual biker that bikes to school from home, which is a short distance. They stick to the same route unless there is a road condition that blocks them off. Sometimes, they run errands between going from school and home.

“Jesse” is a biker who cycles only to run errands. They stick to the same route if conditions allow. They always check the weather before going on the bike. They cycle less routinely as their errands schedule is flexible.

## Briefing

Hello! Thank you for deciding to take the time to help us test our application. My name is \_\_\_\_\_, and we are students at UIC. The goal of our user testing today is we want to increase our understanding of how users navigate through our biking application. We need your help to be able to understand if there are any flaws in our app that we haven't caught. This will take anywhere from 15 to 40 minutes. We will give you four tasks to complete through this testing, and they will be presented to you one at a time. While navigating these tasks, please speak out your thought process, such as why are you clicking on something, what are you thinking, what do you see, what are you looking for, or if anything looks weird or unusual. These tests are about our application and we would really appreciate your any honest feedback, comments, or suggestions you might have, so please feel free to speak out loud with no filter.

As for our app, its purpose is to centralize the most important information of a cyclist's route in the city. That information is what allows someone to prepare properly before going on their bike. One of the most important aspects we want to test is how quickly a user can obtain that information if they are in a rush.

## Tasks and Testing

1. Find the route: “To School”.
2. Check for any road condition concerns along the “To School” route.
3. Check the weather information on the “To School” route.
4. Start your route (bike lane or not)

## Observations

### Person A:

- Went to the search icon immediately rather than the menu. They want to find what they need while making the cost as small as possible.
- Confused about the bike mode button. The icon and label do not seem to be communicating what the button's purpose is.
- Amazed to see the icon pop-ups.
- Click the middle icon and it goes to the upper left-hand corner. This part is not consistent with the other icon.
- Confused about the “blue dot” on the start screen. The metaphor is not clear.

- Played with the “Bike Mode” and “Start”/“End” buttons before trying to figure out the weather condition. The weather icon does not stand out.
- Found the weather icon by zooming into the map. The time it takes to complete the action can be reduced by increasing the icon size.

**Feedback From Person A:**

- Hard to find the icons (black on black/gray) and “drowned in the name of the streets.”
- Had to look along the whole route to see if there were any issues.
- Instead of finding the obstacles, it would be better to see them when the route is selected, which could show a list, then clicking on an item of said list can bring them directly to the scene (or have a button that could list all the possible obstacles.)
- What is bike mode on versus bike off questions (need to better explain it/tutorial).
- Allow having different routes
- Having the saved route shortcuts is nice to move quicker.
- When biking they usually figure out where they are going, then figure out general ideas rather than any specifics.
- Pull out their phone while riding. If they know bad weather, it makes sense to reroute or let them approach/figure it out.
- App has nice to know information, but it doesn't really impact the route such as foot traffic.
- Road conditions...does it impact abilities? (construction is blocked up) Ranking scale of severity.
- Suggest routes based on avoiding bad areas.

**Person B:**

- They immediately went to the “search” icon to find the route. The “Routes” label does not stand out.
- Found the weather and traffic icons with their information immediately.
- Confused as to where the weather, construction, and traffic conditions apply on the route/area. Current visual feedback in that form is not enough.
- The dashed line is confusing. There could be a lack of consistency in terms of color.

**Feedback From Person B:**

- Is the weather just for an area, or is it more general on the route?
- Explain what bike mode is.
- Make the icon at a specific location.

**Person C:**

- Immediately went to the “search” icon to find the route. The “Routes” label does not stand out and blends into the map.
- Was able to find weather and road conditions based on icons, making the metaphors understandable.
- Confused about the exclamation mark. It is not consistent with the other metaphors.
- Zoomed in and zoomed out to view the hazards. The hazards are too small to see.

- Looked for more things. They were expecting more features.
- A bit of confusion about the bike lane button. The button's icon and label is not clear.
- Missed the start. The button seems to be too small in a webpage form.

#### **Feedback From Person C:**

- Did not see the route at first. Make it more clear.
- Make the icons bigger and/or more noticeable.
- Confusion on the route with bike lane mode on and what the differences are. Looks similar.

## Analysis

Regarding learnability, the interface does not connect the system and user model as evidenced by all users who have vocalized their confusion as to what “Bike Mode” means. One way to deal with it is by renaming the button to something more direct such as “Bike Lanes ON”/“Bike Lanes OFF”. Another issue with the conceptual model is the placement of the icons on a route. User B vocalized their confusion as to if the concerns applied to specific areas on the route or a larger area. This can be solved by adding more clarification on the route; If the warning applies to a specific part of the route, having that part a different color (particularly the same as the icon) could be added since it is consistent with other popular map interfaces. If it applies beyond the route, adding a more descriptive message in the pop-up can clarify that confusion. When looking for the “To School” route, all three users clicked the search icon because they were “searching” for a route. Instead of having the user click the search icon for searching specific, singular locations, the icon can be replaced with the search bar to clarify our intent. This would let the user know to not look in that area for a saved route (theoretically, we would allow them to search for a saved route, but this was not implemented for testing). There was also confusion about what the green dashed line in a part of the route meant as stated by user B. To fix this consistency problem, the color of the dashed line should be the same color as the solid line in the rest of the route. Aside from conceptual model issues, there is an issue with the metaphor of an exclamation mark as noted by user C telling us directly. A more recognizable metaphor would be a pedestrian crosswalk sign which brings one’s attention to pedestrians on foot. Going along with the topic of metaphors, the blue icon in the opening screen’s map confused user A. Replacing the current one with the vector icon that shows the direction the user is facing can quickly allow them to recognize what the icon is because The same kind is used by popular map apps. Finally, there was a consistency issue where the pop-up of the middle icon on the route went to the upper left corner. A simple solution would be to fix the code and test to ensure that it appears in a similar location relative to the icon it is tied to.

Regarding efficiency, there was an issue according to Fitts’s Law; Users A and C zoomed in on the map to see the icon and click on it, increasing the time it took to move the cursor to the target. An appropriate solution is to increase the size of the icons greatly, which would reduce that time, according to Fitts’s Law. There was a similar issue experienced by user C where they missed pointing and clicking on the “Start” button. Because it is smaller in webpage form, we can make sure the size of the button is larger on a bigger screen by making sure the button’s size is calculated using the screen width.

# Reflection

*Things we learned during the process:*

- Solving each usability problem is not possible because the usability problems balance each other out and the implementation depends on a specific group of users.
- Having a simple UI at the front and backing up with an advanced options menu could increase the number of users.
- Paper prototyping is the easiest way to check usability problems.
- Learned specific terminology for design techniques that we had all seen in the past. For example, Fitts's Law, chunking, and learning keys for safety.
- We also learned how to conduct heuristic evaluations on work and learned the core principles that are applied in evaluations.
- Learning how to balance ideas, and iterate. As we were a team of five, we had to learn how to decide on items as we wouldn't want to be on the phone for five hours discussing buttons. Additionally, we learned how to look at all our designs, find the elements that we thought worked well in each, and likewise found the elements that we thought didn't work well, evaluated any feedback we received, and combined the best pieces to create a cohesive end design.

*Things we would do differently:*

- Integrating a form to get user feedback after each route for future development of the project.
- Implementing voice feedback while biking was one of the best features that could be integrated into the project. Since bikers cannot read the hazards they are passing while biking.
- Applying features similar to what Google Maps has. For example, showing a tilted version of the map, and having multiple different layers of maps like indicating traffics, transportation lines, and satellite map.
- Showing a list of problems showing on the side of the map once the route has been selected because testers told us that harder to see the icon along the routes. Thus, integrating a list of problems with a few keywords. Further development of this future could be voice reading on these problems.
- Instead of having a drawer-like menu, implementing a pie menu on the screen could be easier from a usability point of view.
- Incorporating a compass to let the user know which direction they are facing. Also, giving voice feedback on which turns to take while on route.
- Taking more risks with our original design. As Google Maps/Apple Maps already exists, it paved the way for a lot of comparisons of our app to that software. This meant that people expected features that were on those softwares, if we had taken a bigger risk with our original design, the original comparison might have been a bit weaker.

*Process description of choosing what features to prototype and the technique used to make the prototype:*

- Our team followed the scenario we started with. The scenario mentioned shortcuts of routes, any safety issues that the user should be aware of before starting the route, and routes that are safest and most efficient in terms of time and distance.
- One way we chose features to prototype was partly based on the original paper prototypes we created. As we all came to the table with three designs, we went through, discussed each design, and created a list of what implementation of features we liked from each. Then, we reviewed the list and found commonalities between them and split it into three base designs that we further developed based on our scenario.

*(Techniques:)*

- Creating an interactive interface using the direct manipulation method.
- Used recognition rather than recall by integrating popular icons like Magnifying glasses for search functionality, weather icons to indicate weather information, and maintenance cones for alerting road constructions.
- Tried to be as clear as possible using keywords like Bike Mode, Routes, School, etc.
- Through making our prototypes we made sure we all got a say and everyone got some input. For the paper prototype, we all drew designs and the best parts of all our designs that went together went into our first prototype.
- After that, we used Figma for our computer prototype. Similar to Google Drive, Figma allows collaborators to work together in real-time, so we would all get on a voice call, and went through our paper prototype and the feedback we got from it as we developed the pages. We divided the work up and then came back together to make sure the design was consistent throughout and the buttons worked.
- Finally for our final prototype, we use GitHub to make sure everyone was able to access all the documents and code needed. Similarly, we reflected on our past feedback on what we wanted to change, divided the work, and at the end, we went through and made sure the design was consistent throughout.

*Things we learned during the evaluation process:*

- Our application must be consistent with any similar popular applications so that users would be already comfortable with using the application. Put differently, instead of relearning a completely new interface, it would be much easier to learn the familiar UI that the users have been exposed to.
- Users are open to any suggestions that are made during the route. Users were asking whether the application would suggest different routes if something comes up on their way to the destination.
- Implementation of a color-coded hierarchy to help user to determine the system's current state.
- Feedback is incredibly important to hear as it is easy to become single-minded on one task. Getting honest feedback can be a bit tricky, however, as occasionally users might feel some pressure and it is also hard to collect users to be tested.