Flare (Group 14)

Project Description

Flare is a smartphone and smartwatch app that helps cyclists travel safely at night. It integrates gesture-invoked signaling with the option of a turn-by-turn navigation system to help guide bikers in low-light situations. Using a standard cycling signal showing your intent to turn will illuminate the watch with a strobe, making you visible to motorists. When your hand moves back to the handlebars, navigation instructions are displayed to guide you along your route.

Brainstorming Process

Our group was all over the place with our brainstorming process at the beginning of class. One of the things we struggled to get our heads around was creating novel applications that featured the smartwatch as the centerpiece of the user experience. This could be attributed to the fact that none of us had ever owned or used a smartwatch, and were tied down to our preconceived notions of what a mobile app could be. We also had the hurdle of being overly realistic, and often-times this conflicted directly with our hope to be original, so many of our ideas were a bit too boring. We also struggled to create apps that were not in the taboo groups of *Shopping, Gym/Fitness, Games, Cooking,* and *Scheduling.* We came up with a bunch of ideas, the best of the three being

1) **Classroom app for smartwatch:**
    a) This app would allow students to raise their hand and notify the teacher of their name (on the teacher's smartwatch or tablet). This would allow for better participation. The app could also have iclicker choices on the watch to take quizzes/attendance.
2) **Restaurant app for servers and bus-people:**
    a) This app allows for better communication between restaurant workers for efficient task scheduling and better customer through-put. Customers could hit a button on their smartwatch to get assistance from staff.

Servers could be notified by bus-people when a table is ready, and the servers could notify bus-people when a table is ready to be cleaned.

3) **Camera Stabilizer app:**
    a) This app takes in accelerometer data from the person's wrist the stabilize the image when they're taking a picture.

We were pretty excited about these apps. However, the TAs let us know that we weren't thinking outside the box and capturing the benefits of having a smartwatch as the centerpiece of the user experience. We ended up thinking harder about how to use the accelerometer on the watch as a differentiator for our app.

Then flare was born! We realized that cyclists commonly made signals while on the road, which could be the centerpiece of an application. Our feedback was good, but let us know that we should include extra functionality to differentiate ourselves from other signaling applications. This is why we added the navigation system. We decided that our target users would be *night-time cyclists*, notably *bicycle couriers*

Personas

For flare we were stuck between two main personas. We thought these accurately depicted who we were designing our application for.

Persona #1) Jenny, a 15-year old high school basketball player

- Jenny is from Irvine, CA and attends Northwood High School
- Jenny puts long hours in at practice and at the library after class every day. Unfortunately, her parents are pretty busy so she ends up needing to ride her bike home after practice every night. Her parents are worried about her safety because there have been several incidents in the area involving motorists not seeing cyclists crossing the street
- She knows the bicycle signals but generally doesn't wear reflective gear to school, so she doesn't wear it on her ride home either.
- She knows her ride home, so navigation is not important for her

- Jenny recently received an Applewatch for her birthday and is excited to check out some of the new apps out for it. Her parents hear about Flare and have Jenny download it. Now she can ride safely at night

Persona #2) Phillip J, a 26 year old bicycle courier

- Phillip J works for Pedal Express in the East Bay
- He often works into the night, when visibility is limited. He is worried about his safety regarding cars. His bicycle has flashing lights on the back, but those do not convey his intentions when he wants to cross the street
- His routes are constantly varying, so he uses the navigation system on his phone a lot. This can be annoying to handle, so he recently got a phone mount for his bicycle.
- This phone mount is annoying to him, however, because he can't drop his bike on the ground and needs to be much more careful about where he places his bike

We realized that both of these persona's need the gesture-invoked signaling to work flawlessly. The strobe must be as visible to motorists as possible, and gestures must be easy to use. The navigation was really only important for Phillip J, though Jenny might take a trip to the store every once in awhile.

Contextual Inquiry

We set out to interview three cyclists to see how they perform tasks on the road with their bicycles. We interviewed casual riders as well as competitive cyclists. Unfortunately, we were unable to secure an interview with an actual bicycle courier. We hoped to glean a similar take from the competitive cyclists, who also spend large amounts of time on their bikes out on the road.

Interviewee #1 (Casual cyclist)

We interviewed him at a spot near his home where he frequently begins his bike rides. He brought his bike out and showed me the arm motions and gestures he uses to communicate with traffic while he is riding. Clark hopped on a second bike that he had and went on a short ride with him to observe what a typical trip would be like. The signaling gestures were demonstrated, and he also talked about biking situations when he had to be most cautious. The general theme was safety and avoiding collisions, and most of the tasks he had to do while biking surrounded this theme.

After this short ride, we talked more about cycling and safety. He brought up **communication** and **visibility** as the two main factors that determine whether or not a biker will get in an accident. **Signaling lane changes and turns are crucial,** as well as communication to other bikers and cars driving behind you. He identified dusk as being the most dangerous time of day or night to ride, since the effectiveness of headlights is diminished at this time. He also mentioned the annoyance of intersections with no left hand protected lanes, as oncoming traffic does not stop in this situation.

We then brought up the idea of this app and received his feedback on it. He strongly approves of this idea and believes that it would definitely increase the visibility of cyclists as well as improve their ability to signal and communicate with traffic, thus improving overall safety. He also suggested some other features that would personally improve his riding experience. One of these features is use of voice control to edit or add destinations, as well as search in real-time (while biking) for places that might offer what he needs at that moment. For instance, if he's thirsty from a long ride, he can just speak into his watch "convenience store", confirm a destination, and begin the navigation all from his wearable (he owns a Motorola 360 and believes this is a viable feature to implement). Overall, as a cyclist, this app idea would really improve his biking experience.

Interviewee #2 (Competitive cyclist)

I interviewed him while walking with him from north-side of Berkeley to south-side, while he was pushing his bike. This allowed me to actually have him demonstrate his actions while biking to me, while travelling down Piedmont. While walking behind him, I was able to watch him as he biked into intersections, demonstrating what it looks like from a car or bike behind him, and seeing what gestures he would use to signal towards the people behind him. While discussing the long distance road trips that he would be involved in, we discussed the tasks that a bicyclist must to to remain safe in both cities and remote rural roads, and the similarities and differences between them. The conversation discussed the tradeoffs between safety and convenience for a cyclist, and how to avoid collisions while knowing where to navigate, and remain noticeable at night.

During the ride, we first talked about one of the most difficult and dangerous tasks for a rider is crossing. The danger of turning left isn't actually the turn itself, but the lead-up before the turn- crossing lanes of traffic from the right side of the road (the biking lane) into the left turn lane. The rider **needs to signal to cars in the road at least 100 meters before the actual turn, and get to the left side of the road.** This is very difficult and dangerous, especially in heavy traffic. **At nighttime, the difficulty in signaling to (often very fast travelling cars) is exponentiated** compared to daytime traffic. Without any aids (like blinking lights), the usual way for my interviewee to signal to other cars is to point with his finger, and shake his arm to be more visible.

One other task for the rider is navigation, which most commonly currently depends on smartphones. The rider either mounts a smartphone on his handlebars (although he dislikes this and cannot use this in rain), or keeps it in his pocket and checks on it when he needs to. Neither of these options are particularly good, as the only way to receive navigation alerts with a phone in his pocket is to keep earbuds in his ear. This is bad, as it prevents the rider from being as alert to the road as possible.

One unique discussion is the aspect of "control". Control is a function of how comfortable someone is on their bike, in any given situation. Something like a pothole is no problem for an experienced rider. For an inexperienced rider, the lack of comfort and familiarity with the bike translates to a lack of control. My interviewee told me about an inexperienced friend of his, who had trouble at a stop sign, toppled over, and had his bike ran over by a car (fortunately, no injuries). Any attention diverted from the road translates to a loss in control, as this means that there is discomfort in this situation (a rider checking a smartphone maps app, for example). This gives perspective to an insight that the aim is to increase control for the user of our app by doing things that add to how a user is comfortable with the situation, which increases the safety of the application.

Interviewee #3 (Competitive Cyclist)

The interview involved looking at the bike while biking up and down a street. As the interviewee rode on the bicycle, he covered several topics about things that are important for cyclists as for road biking, as opposed to races. These involve gestures that cyclists use to alert other people, how cyclists interact in turns, how left turns are different from left turns, and how cyclists behave in lanes, and riding on the side of the street when there is no dedicated bike lane.

First, **he described that there are several hand gestures that cyclist use while riding their bike.** The most obvious gesture is the ones that direct other people whether the cyclist is turning left or right, or slowing down. One of the hand gestures is pointing his hands down, pointing to object that can be dangerous, or hole. This alerts cyclists to dangerous debris that would cause cyclists to lose control The other gestures are hands down but open palm, to explain that there is a glass or debris that can harm other cyclist. Running over debris that are dangerous would cause a flat (such as glass shards) or lose the ability to slow down (such as oil slicks).

He also explains that the hard thing about turning is turning left, because bike usually in the right side of the road. Left turn is the more difficult thing because there are usually lots of traffic. Cyclist rarely go into the lanes, but mostly just for turning left. When turning right, the cyclist does not need to worry about traffic and interference, but can just turn directly into the lane on their right. **However, for left turn lanes, the cyclist needs to worry about the city traffic in order to properly merge into the left turning lane, and signal to cars and riders that they are about to turn.**

Some other gestures that he mentions are light flash that bounces off the rider and people behind sees it. The different signal indicates different turn or signal. Also, for most of the time, they did not remove their hands off the handle bar, but just glance above their shoulder. These signals and hand gestures usually hold there about 5 to 10 seconds until it is clear for cyclist behind them.

He then mentioned biking at night and raining situations. Most of his rides at night was commuting to places. It is usually not for competition, since most competitive biking is done during daylight. Since it is dark, and cyclist usually have only small reflective light behind them, it can be difficult for cars and other commuters to see a cyclist. They have to be more careful and aware of others around them. While in raining, it is even more challenging. Brakes are hard to control and the road is super slick. If a rider wears dark colored shirts, it would be invisible from a driver’s point of view because they get distracted by water on their windshield.

While commuting, usually the interviewee knows his routes already. But when he rides into new places or a new town, he usually needs some navigational aid for the routes. **He loves how his Apple Watch works while driving, and wishes it would apply to cycling.** He said “five bumps for incoming turn, three for left, and two for right turn. It is really nice that you can check next steps every time”. He also mention how some amateurs use a phone attached to their handlebar; however, this is not very convenient and helpful for a pro cyclist.

Lastly, and uniquely, he covered how bicyclists deal with roads without bike lanes. In California, not every road has a bike lane for bicyclists to ride in. This can create additional dangers for riders, such as car doors opening from parked cars, or cars turning right that do not pay attention to cyclists. In order to stay safe on the road, the rider must be able to signal to other people in a way that attracts attention even when people are not paying attention and looking specifically for a cyclist.

CI Lessons:

We learned a good deal about cycling and safety on the road. One thing that was common across all interviews was the danger that cyclists face on the road is primarily from crossing the street and turning. All interviewees agreed that at night, the danger is much higher. While the interviewees might have reflective lights on their bikes, they agreed that these lights did not do much to signal their intents on the street. Our interviewees also were familiar with the standard bicycle signals, including right turn, left turn, stop, and pointing out hazards.

Some of our interviewees also expressed interest in a more streamline navigational experience for their bike rides. One complained about the clumsiness of bike mounts, and mentioned that he loves his Apple watch for driving directions and would love a more bicycle focused version for his watch.

Other than receiving validation for the signaling and navigational focus for our app, we also realized from the interviews that the interface must be minimalist. Bicycle riders have enough to focus on on the road, and being distracted by a smartwatch application with too much information could be detrimental to safety. We also learned that all actions performed by the user should be easily performed while balancing on a bike (obviously), so that needed to be taken into account.

Task Analysis

After we finished our Contextual Inquiry interviews, we wanted to synthesis what we learned more concretely. To do this we turned to Task Analysis.

1) **Who is going to use the system?**
    a) Cyclists who travel on city or busy streets, either for leisure or commuting to work. Wish to travel safely and avoid collisions through increased visibility, particularly in high risk situations such as going through intersections or biking at night/dusk.
2) **What tasks do they now perform?**
    a) Signal with arms to communicate with drivers and/or other bikers to convey information. Not always effective since visibility is an issue.
3) **What tasks are desired?**
    a) Signal and communicate effectively with drivers and bikers with increased visibility by using a gesture/navigation triggered light on the cyclist's smart watch. Search for, edit, or add destinations in real time through voice input to eliminate need to stop biking and pull out a mobile device. Be aware of when to make a turn in a comfortable amount of time without taking cyclist's attention off the road.
4) **How are the tasks learned?**
    a) The tasks of signaling and turning safely are taught to users by other bikers who are on the road (Marc from the interviews attests to this). Any user who has received a driver's license has also learned these signals from the DMV. Bicyclists might also have taken a bicycle safety course when purchasing/renting their bikes. Couriers go through safety training. Bicyclists learn to navigate by looking up directions ahead of time or knowing the streets around themselves well.
5) **Where are the tasks performed?**
    a) Tasks are performed outside on the street, usually when a bicyclist is on a trip, and turning or navigating.
6) **What's the relationship between user & data?**

a) Users like to know when to turn. They also like to have data about the distance and time from their destination. They also like their routes to be private

7) **What other tools does the user have?**

a) There are other competitive smartphone apps that track user position, but are not targeted towards a safety audience. The user usually mounts a smartphone to the bike in order to use these apps. Cyclists can also use flashing lights on their bikes, but those don't change when they signal.

8) **How do users communicate with each other?**

a) Cyclists use variations of signals to communicate with each other (without the app). They signal with their arms in various ways to indicate debris, obstacles, glass, and their decisions to turn to users behind them.

9) **How often are the tasks performed?**

a) Every time the user needs to make a turn on the road, the user will need to signal and know where the turn is. The application is supposed to help guide both these needs- to guide the user into the turn, and make the user more visible for the other people on the streets.

10) **What are the time constraints on the tasks?**

a) Many of these tasks are performed quickly, in a matter of seconds. Signaling is done on the fly. Some users might have time constraints on the length of their ride, so the quicker they can finish a task, the better. Getting directions while riding a bike will need a precise timing yet notifying user long enough before he can make sure make the turn. While it is hard to see the notification, it should show clear info since user can only look at the watch a few second.

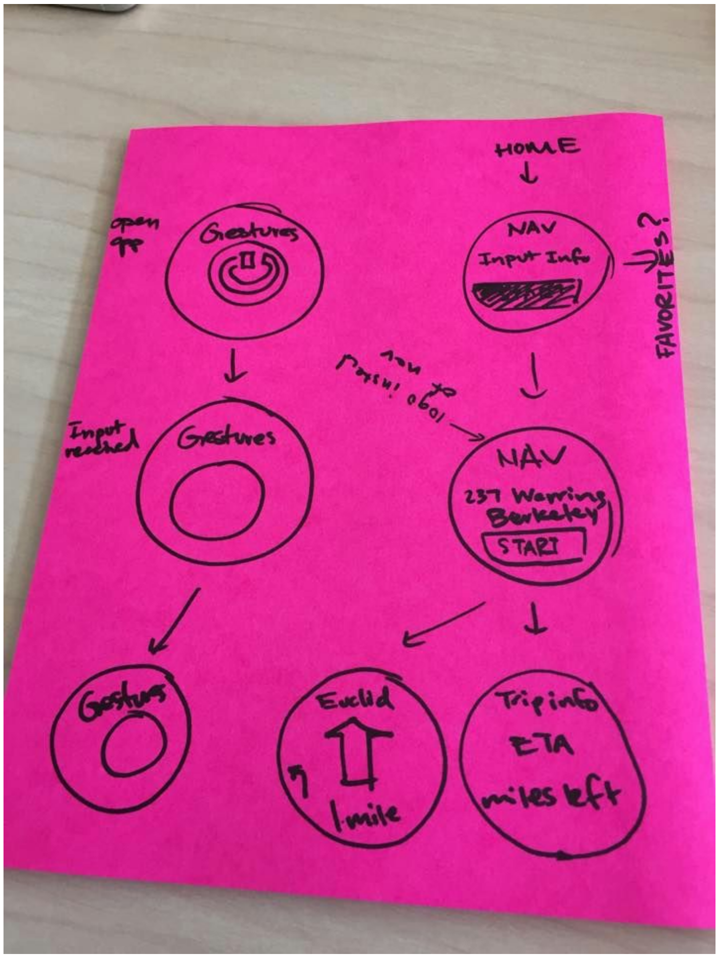
11) **What happens when things go wrong?**

a) The worst-case scenario is that a cyclist can be hit by a car or another cyclist. Our app aims to provide safety for our users in the dark/rain. A user can also get lost if their intuition/directions are wrong, or if they lose track of their directions. Having directions on their smartwatch helps them with this.

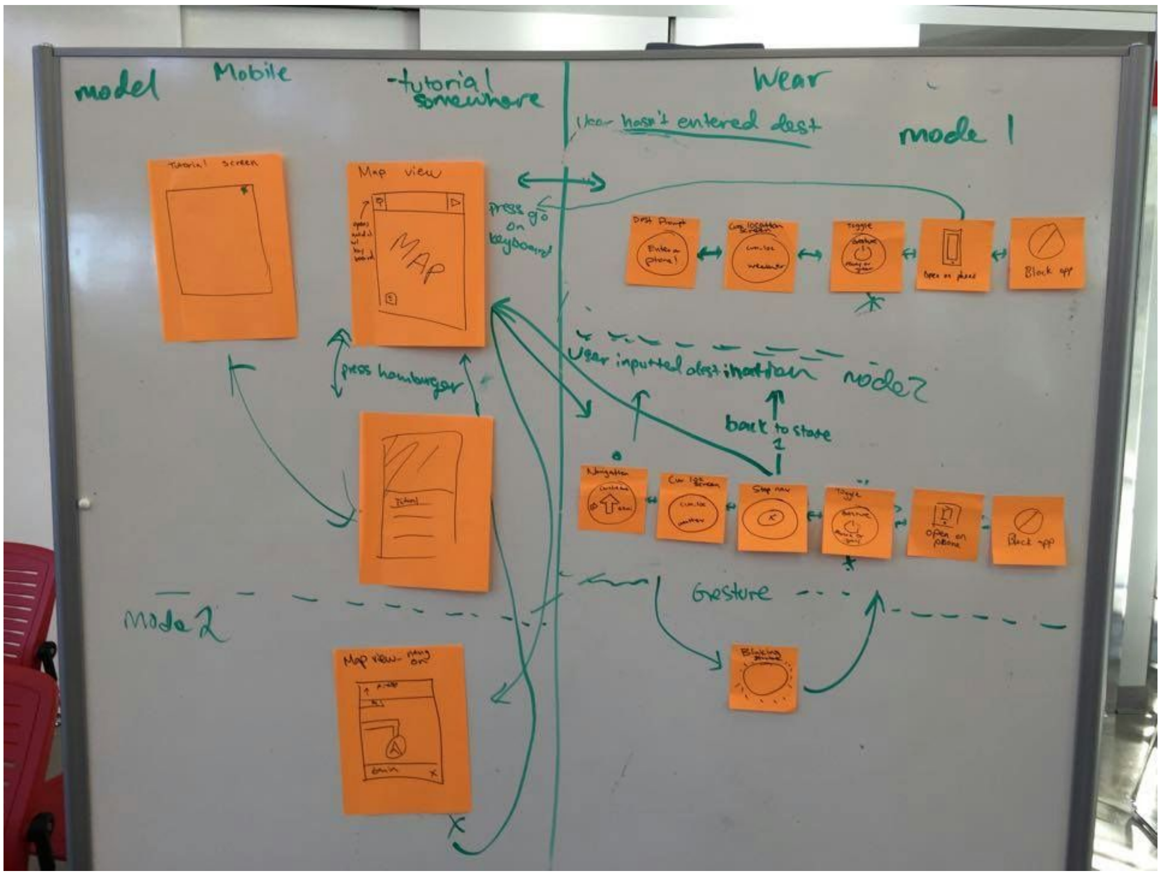
This task analysis helped us verbalize the actions that these cyclists would be performing on the road. This was critical in motivating our initial wireframes

Initial Wireframes

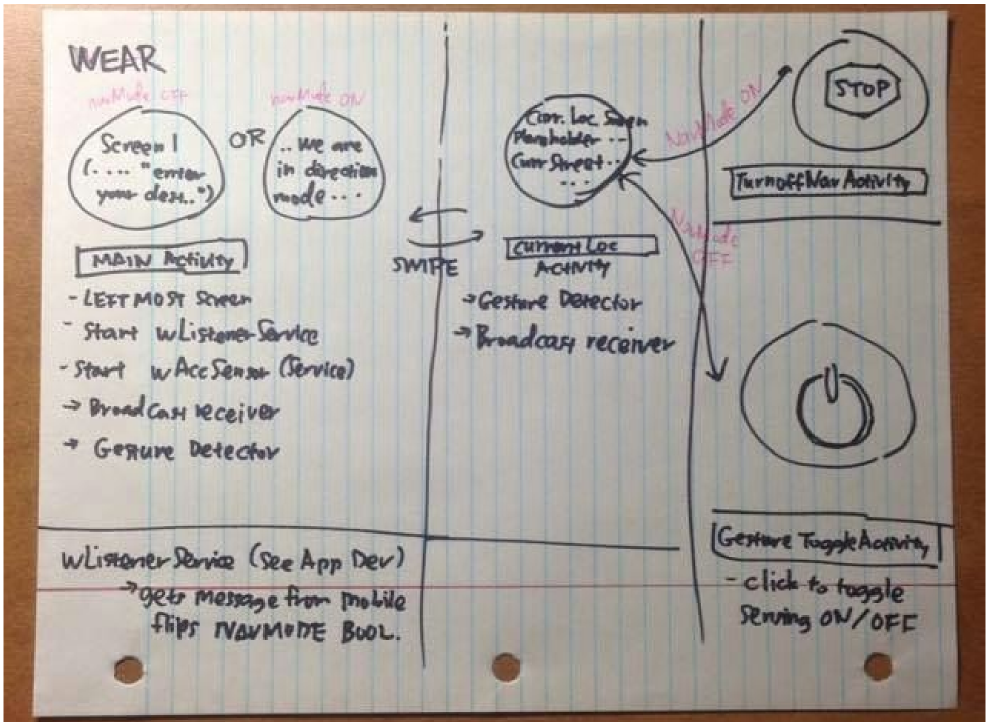
This is the first wireframe we drew. We knew we would need to include navigation instructions, current location, some kind of toggle for gestures and navigation. We also included trip info into this prototype.

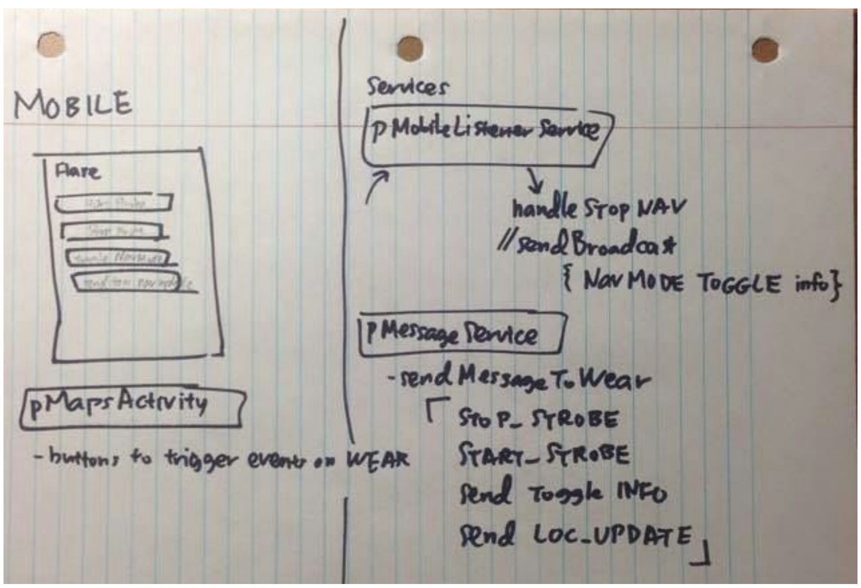


After some iterations, we came up with this writeframe. This was almost the finalized workflow of our app. After testing our app and getting feedback from actual user, we find out that the most important part should be on the left while the least is on the right side. So, we put navigation on the left screen, then current location and gesture toggle on the very right. We also finalize the 3 mode we have; without navigation, navigation, and gesture signal. From this, we can easily create our skeleton code and excel forward faster than we have thought.

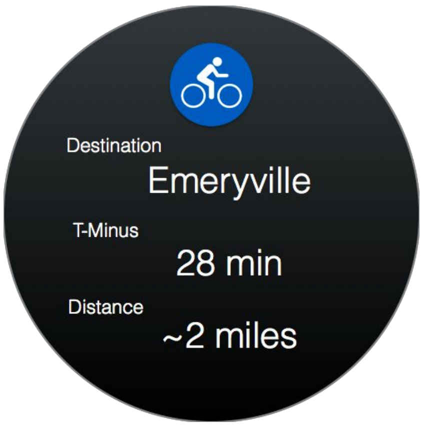


These two figures show our initial design for the skeleton and flow of the app.





Intermediate Watchfaces



We originally wanted to show cyclists as much information about their trip as possible. The more information, the better right? After user testing, we realized that we were overloading the user with unnecessary information. Cyclists really cared about knowing the next turn they were making, so we changed our designs to reflect that

We also originally wanted to have our settings and buttons mostly on one screen.

User testing showed us that this isn't a great idea because of the fat finger problem.

We also had a "Time to Turn" screen. We changed this by removing the screen altogether and just adding a vibrate to the watch when it was time to turn.

Here are our screens related to signaling. We originally wanted arrows to show the direction of the user turn, but it was unrealistic for a driver to see the arrow, so we ended up removing it.

We then transitioned to this

We were uncertain for a while what our mobile-side would look like. In initial development we expected just a simple “plug in your address” and map functionality. This was changed later on

User Testing

The experiments were carried out by the team in order to test the usage of our app in a real, physical environment. The team had specific roles for each member, who followed the script for the user tests, evaluating the responses of the user interacting with our app prototype. This involved greeting the user as an introduction, explaining the usage and procedures for the app prototype, and walking the user through three completing three tasks.

Experiment Protocol

Our testing environment was designed after a typical use case for a cyclist. Therefore, we decided to test our prototype on the streets around Berkeley, with the interviewees riding on bicycles. For safety purposes, we stayed on side streets that had less vehicle traffic that may interfere with the experiment. The prototype is tested with a designated “computer person” who is standing with a laptop in front of the user riding the bicycle. The computer will emulate the gestures (using framer.js) that the user makes on their dummy watch, and display the results to the user. The “computer person” changes the framer.js prototype as the user directs them to, while the user is still on the bicycle.

The testing procedure follows a series of steps that allows the user to go through the process of completing the three experimental tasks. Initially, a team member in the role of the “greeter” will greet the subject cordially, and lead the subject to the test environment. The “greeter” also explains the background of the experiment and the general idea of the experiment to the interviewee.

Next, a team member in the role of the “facilitator” introduces himself and also explains the details of the app, including the app’s target demographic, goal, and capabilities (signaling and navigation). This includes explaining the main features of the app to the interviewee: to allow cyclists to be seen at night by others on the road by giving their safety signals a bright strobe via their smartwatch, and to eliminate the need to constantly check smartphone for navigation directions by pushing directions to their smartwatch. The “facilitator” then explains to the user that he/she will be testing the app, while sitting on the bicycle. They will be in possession of a dummy phone and watch, which will be used to simulate actions, while the actual responses to the dummy devices will be seen through the framer.js hi-fi prototype on a laptop positioned in front of the bike. The “facilitator” gives the user a watch (potentially just a regular time watch) and a smartphone for the experiment.

Then the facilitator walks the subject user through the three experimental tasks, without telling said interviewee how to accomplish each task. The tasks are: signaling with the watch, looking at the watch for directions, and turning gesture-sensing mode off or on. The subject will be looking at the computer person” to see responses to their dummy devices.

For the first task, the “presenter” explains how the app has built in signalling. The presenter tells the subject to imagine that they are riding the bicycle. Then, the presenter instructs the subject to signal that they making a turn or stopping, and then stop the signaling. After the subject fully answers and attempts to complete the task, the presenter asks: “How can we improve that? What feels more intuitive?” For the second task, the presenter again instructs the subject to imagine that they are riding the bicycle. The presenter then asks the subject how the subject would check their next navigational directions. After they fully answer and attempt to complete the task, the presenter again asks about what can be improved, and what aspects feel intuitive and/or unintuitive. For the third and final task, the presenter instructs the subject to imagine that they are on the bicycle, and want to turn the gesture-sensing signals mode off/on. Again, after the subject fully answer and attempt to complete the task, the presenter asks the subject for what areas needs improvement, and what aspects are intuitive and/or unintuitive. As the subject is finishing the tasks, the

“facilitator” is recording the direct responses and noting issues and other non-explicit problems that the user ran into, and assigning severity ratings to each of these issues.

Testing Reflection

We learned a lot during our user experiments. Some were major and some were minor, but none of the issues got in the way of us being able to provide a helpful application to cyclists. We had three main usability problems:

1) **Users couldn’t figure out how to use the turn signal gestures properly**
    a) This could have been an effect of not fully integrating the user into a moving environment in which they could have felt like cycling gestures were appropriate. Them not understanding could have been alleviated by a tutorial (we originally assumed that most cyclists know how to gesture their intents, but this wasn’t exactly the case when we interviewed more casual riders). We can show the tutorial whenever the user opens the app for the first time, and can also provide a question mark button that can re-open the tutorial if the user wants to be reminded of how to use the app.
2) **Users also had trouble swiping the gesture-sensing capabilities off**
    a) This was because the gesture toggle button was a slider, but because navigation through the app is done through swiping left/right, the user could end up making an unintended action. We can fix this issue by changing the button to a click button instead of having it as a slider. We can also add colors to indicate whether gesture sensing mode is on or not.
3) **User’s couldn’t understand the navigation system’s notifications**
    a) This could have been fixed through the initial tutorial. We also conformed to industry standard for vibrating smartwatch navigation so that will help some users who are already acquainted with

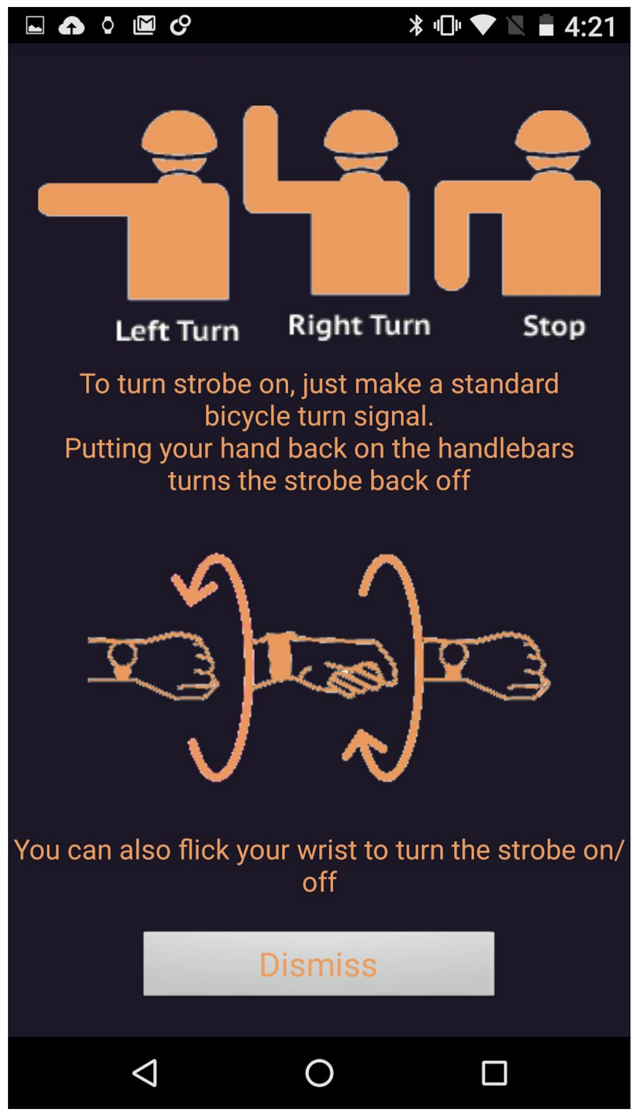
Inspired Changes

1) **Added a new-user tutorial**
    a) This is triggered when the application is loaded for the very first time. This will explain the gesture system so that riders who are not acquainted with bicycle arm signals will be able to understand how to perform the strobe action.
2) **Changed gesture toggle screen**

a) We changed the gesture-sensing mode toggle to have a click button instead of a toggle bar. We also added color that reflects system status (gestures on/off).

Scenarios

We created a few scenarios to put ourselves in the mindset of the user and to help us understand their motivations, goals, and distractions. We were hoping to use these to validate our UI decisions and understand whether we needed to add or remove certain features



Scenario #1

This scenario involves a cyclist who is a **delivery rider**, and often bikes around at night. The bicyclist would want to be transporting their delivery package to their destination customer quickly and efficiently. As a rider, he/she will be fairly experienced and familiar with signaling gestures that bicyclists use. However, the delivery rider may not be familiar with the route to the destination.

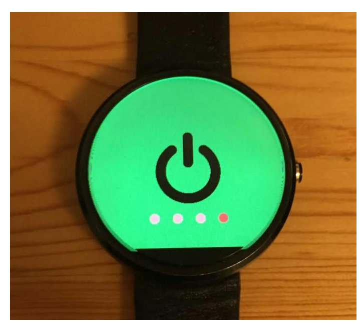
Motivation wise, the courier would want to make money quickly, by delivering packages in the shortest amount of time possible. In addition, the cyclist, like everyone else on the road, has a strong interest in not being a participant in an accident with a car. Thus, the goal is to quickly navigate to the destination, without making any wrong turns or having to stop to check for directions; in addition to increasing the safety of the rider while travelling to the destination. The delivery rider may be distracted by other vehicles on the road, debris and obstacles on the road, and other things that may delay the rider or cause an accident.

From this scenario, we can see that the user is interested in quickly signaling to drivers, and receiving navigation instructions without stopping to pull out his/her smartphone. In order to allow users to signal to others, which increases visibility at night, we flash the screen of the smartwatch (blinking colors) when the user makes a gesture extending their arms signaling to other drivers. This is covered in our tutorial when the app is first opened (seen above). The gesture feature in our app allows the user to quickly turn on signals without needing to stop and press a button.

In addition, we assist the user in navigation by providing very easy, quick to decipher directions, that can be seen from a single glance towards the smartwatch. These directions allows the rider to know the most important facts about the route instantaneously: which direction to turn and the distance until the turn.

Scenario #2

For **another scenario**, we have a user who is a **long distance biker**. This bicyclist would be riding on a bicycle for an extended distance, like from San Francisco to Santa Cruz. As a rider, they would be riding long stretches on roads, without many turns throughout the longer legs of their journey. Motivation wise, the bicyclist would want to steadily cover the distance, while stopping as little as possible, since stopping messes with the pace and heart rate that has been set. Thus, the goal is to bike to the destination, steadily at a constant pace, without making any wrong turns, or having to stop to check for directions. In addition, because of the distance of the bike ride, we would want to have the app use battery at as slow of a rate as possible, so that the user would not run out of battery.



Because of the lack of turns on long stretches of roads, there is less need to signal to vehicles, and the standard lighting on the front and back of the bike suffices. In order to conserve battery, we can turn off gesture sensing on our app, which is enabled or disabled by a button on the smartwatch. Disabling the gesture sensing means that the smartwatch would not enable the blinking feature to quickly signal to drivers, but as a tradeoff, the smartwatch gains battery life.

Competitive Analysis

For this application, all of our competitors were only competing with us on one of our two focus areas. The competitors were either navigation-focused applications of were signaling gloves for cyclists.

MapMyRide **Stava** **Zackees**

1) **MapMyRide**
    a) **URL-** http://www.mapmyride.com/
    b) **Target User Group:** The target user group for MapMyRide is anyone who rides bikes as a fitness activity. This has some overlap with our target user group (couriers/casual riders who bike at night), but our app isn't a fitness app
    c) **Functionality:** The application allows users to track their routes, speeds, calories burned, and other fitness-related metrics. These functions are mostly fitness focused. MapMyRide does not have a wearable extension. Our idea has a different scope, being more geared towards bicycle safety and turn-by-turn guidance. It improves the bicycling experience because a user doesn't need to mount their phone on their bicycle (like they would on the MapMyRide app)
    d) **Usability:** The main challenge for MapMyRide (in comparison with our application) is that there is no wearable companion app, which makes retrieval of information in some situations, like while you're at a high

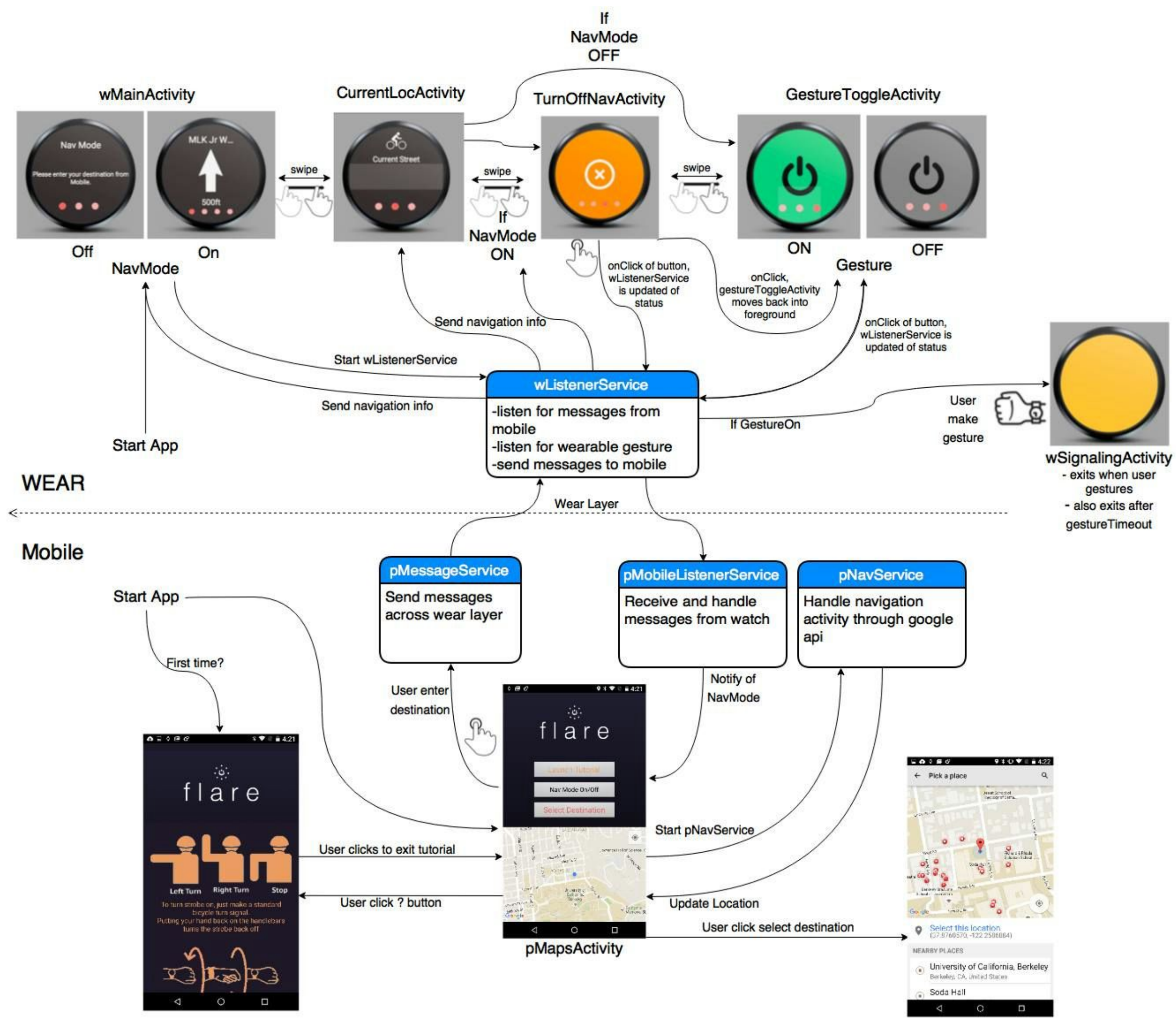
speed, difficult. MapMyRide also is not geared towards enhancing bicyclist safety, as our app is.

2) **Stava**
    a) **URL**- https://www.strava.com/
    b) **Target User Group:** Stava's target user group consists of people who bike, run, or do crossfit. This does overlap a bit with the target user group of our app, but Strava's purpose is to gamify users' fitness experience (as well as track their exercise statistics).
    c) **Functionality:** Users can track their runs, rides, and cross training statistics. There our ongoing challenges that users can participate in. Users can also easily compare their fitness data with that of other users to see how they stand in the fitness community. These functions are clearly fitness oriented, while the purpose of the functions for our app Flare is to ensure a safer riding experience for cyclists.
    d) **Usability:** Strava isn't currently available for wearable devices, which makes it very difficult for users to view their fitness statistics and information in real-time.
3) **Zackees**
    a) **URL**- https://zackees.com/
    b) **Target User Group**: The target user group for Zackees are cyclists who bike at night. These cyclists are dedicated and have the money to spend on gloves that are ~100$.
    c) **Functionality**: This product differs considerably from the other two competitors because it's not a smartwatch application. Zackees are bicycle gloves that have embedded LEDs that light up when you click a button. Zackees does not include navigation, while Flare does.
    d) **Usability:** The biggest benefit of our app over Zackees is that the user does not need to buy an additional piece of equipment if they already have a smartwatch. This saves them money. It also reduces the amount of clutter on the person's arm. Our app is also more usable because there is no clicking of buttons involved, the user just needs to make the signal they need to make (using the accelerometer found in their smartwatch)

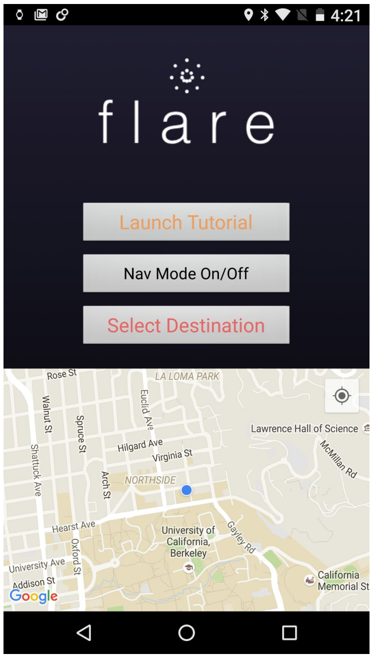
To sum up our exploration of our competitors, we realized that no other application or product on the market right now combines gesture-based signaling with smartwatch aided navigation. We explored the strengths of our competitors and took key insights (like ease-of-gesturing) into account for our final design. Our app gives users the most control over the road at night, enabling them to be safer, more confident, and more efficient.

Final Design

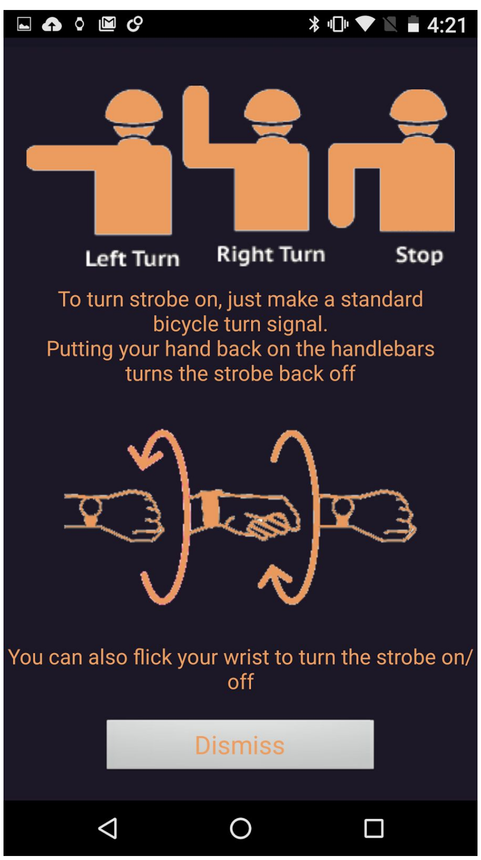
Final App Skeleton/Flow



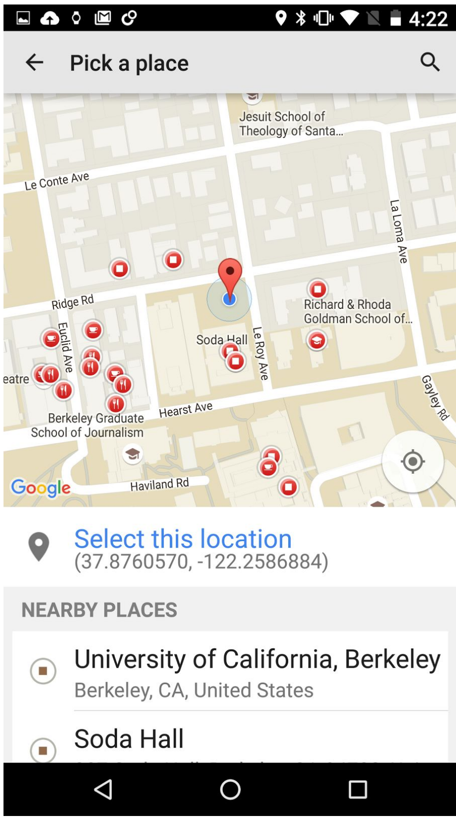
Mobile-Side Design

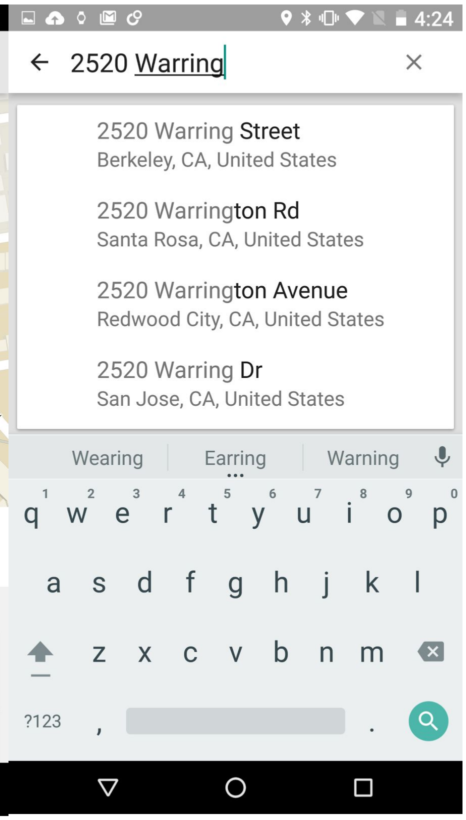


This is our final version of the mobile side of Flare. The top half of the screen contains 3 essential buttons that allow users to see a tutorial, turn navigation mode on or off, and select a destination. The bottom half of the screen is an interactive map that shows users their current location. When Destination is selected, the map displays the suggested route for the user. We wanted to keep this as simple as possible and our design reflects that.



Clicking the tutorial button brings users to this screen, which demonstrates the gesture functionality of the watch. The navigation controls for this app is so intuitive that we do not refer to it here; all users have to do is choose a destination on their mobile device.





Choosing a destination from the mobile app is as simple as selecting “Select Destination” button from the main screen and then selecting a nearby place that is listed. Users can also directly type in the address of where they want to be.

Wear Side Design

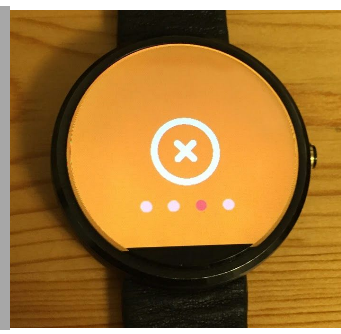
We also wanted to keep the design for our wear app as simple as possible so that users can remain focused on their safety while using this app and biking. We wanted to ensure that all actions that they need to do must be easily performed. The screens shown (like current location and navigation) contain only crucial information, so that users don’t have to worry about sifting through information on their watch screen to find what they need. This eliminated one of the key problems our user tests

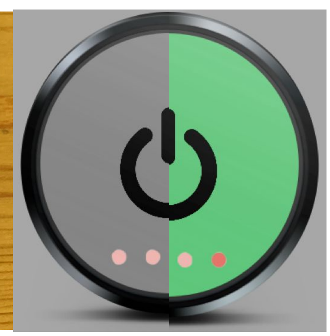
The final watch design consists of either 3 or 4 horizontally scrollable screens. There are 3 screens when Navigation Mode is Off (leftmost screen tells users that they should choose a destination from their mobile device if needed, center screen shown below displays the current street that the cyclist is on, and the rightmost screen has a toggle button that turn gesture sensing on/off). When gesture sensing is off, gesturing with the watch will not turn on the strobe; when it is on, gesturing will trigger the strobe, which can be turned off by retracting the arm.

When Navigation Mode is On and users have selected a destination on the phone, there are 4 screens on the wear. The leftmost screen now displays turn by turn navigation directions to get users to where they want to be. The third screen from the left is now a button that allows users to exit navigation mode and cancel their turn by turn navigation directions, and the gesture sensing toggle button has been shifted to the rightmost (4th) screen.

We believe that our design provides the best functionality that cyclists can get out of this app experience since we've iterated through user testing multiple times and implemented quality suggestions with each iteration.

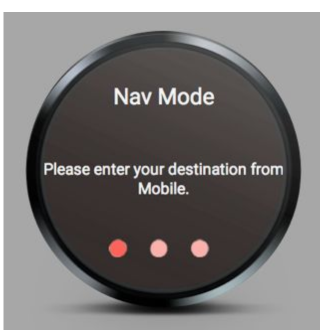
Navigation Mode

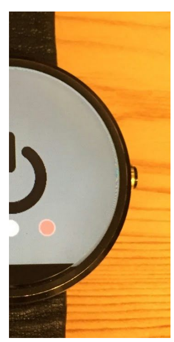




NavScreen Current Loc NavModeToggle GestureToggle

Passive mode





This screen shows the illuminated strobe. The strobe flashes between orange and white and is very noticeable at night.

Technical Challenges

The main technical challenges that we encountered during our implementation were related to **gesture recognition** and **navigation**

Gesture Recognition

The first challenge when implementing gesture recognition was knowing whether user know how to use real cyclist gesture. From several user studies we found out that professional and frequent bikers tend to know how to perform the basic cyclist gesture, however not all know. So we wanted to add a tutorial explaining the gestures.

Next, another more technical challenge was related to the sensor reliability. We know that while biking, there will be so much vibration and movement. This will affect how reliable the accelerometer sensor in moto360. We afraid that the cyclist gesture would not be recognized because there is so much movement. This lead us to implement a failsafe gesture through a wrist-flicking gesture. The user can flick their wrist just to turn the signal off and on in the event of the gesture not being sensed properly. Moreover, we also give user pretty big area of coverage to turn on gesture from the actual correct cyclist gesture.

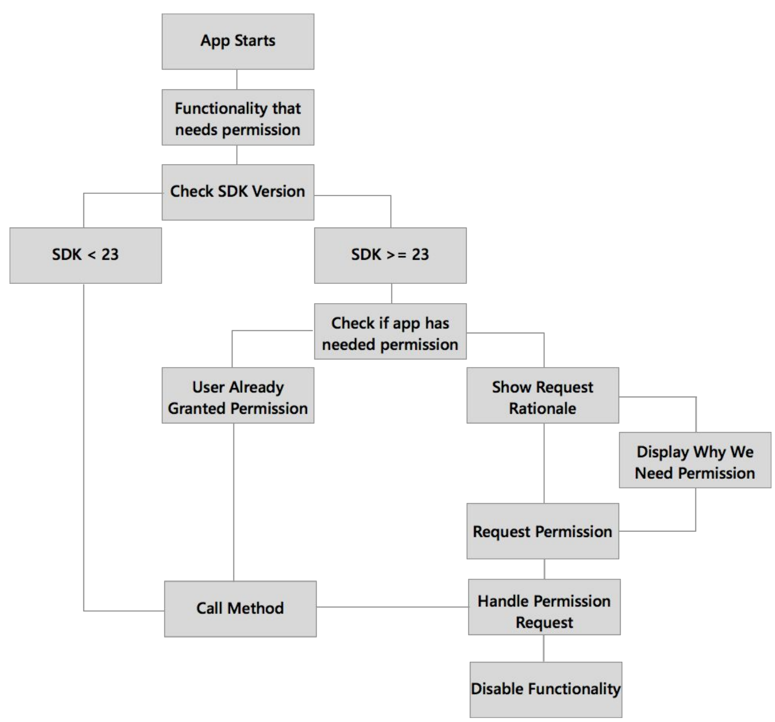
The third and biggest challenge while implementing the gesture recognition related to the case where the cyclist used a vertical handrail. This type of handlebar made a big problem because the cyclist's hand position is very similar to the left turn signal position. The signal reading thinks they almost have the same gravitational position through the moto360 accelerometer. While this problem will occur, we managed to realize that the smartwatch face will face left, not the cyclist, so it does not interfere with cyclist. When cyclist want to look back at the watch to see direction, the signal will turn off itself and smoothly show direction. While the signal still turn on while holding the handrail, we managed to realize too that it is actually more helpful than we think. While the signal turned on, it serves as notification for other road user that the cyclist is on the road.

Navigation

Implementing the navigation feature for our app proved to have several technical issues that needed to be dealt with.

The first issue was implementing a service that checked for the location of the smartphone on Android. This should be easy enough, but documentation for Android is woefully fragmented- there are many different ways to get location on Android, depending on if the programmer is using methods introduced in Android 2.0, 4.0, etc etc. After realizing that mixing and matching documentation methods and tutorial code was a recipe for a non-functional app, we finally wrote a mostly working location detection service.

However, another large issue popped up- the app would consistently crash with a permissions issue, saying that the app did not have permission to



use location features on the phone. The frustrating part of this message was that the app **did** have permissions to use location (both coarse and fine) enabled in the app manifest! It took a lot of googling and cursing to discover origin of the bug. My Nexus 6, which we was using, had been upgraded to Android 6.0 Marshmallow (API 23), which introduced new iOS-like permission systems. I needed to implement a lot more permission checking code in order for the app to work with API 23 as well.

Finally, the last large issue we had was implementing the red route lines for the map, used in the app. Getting the route from the Google Maps Direction API was a fairly easy REST call, but it took a bit of work in order to get it working for showing on the map activity of our app, whenever we want to load directions to a destination. It was work-intensive to get the lines loaded onto the map, and getting it to update with new directions or being removed.

Flare Summary

Flare is a bicyclist navigation and safety application for smartwatch and mobile. With Flare, cyclists now can feel at ease and in control on the road at night. Using standard cycling hand signals, users can display their intent to turn by illuminating their outstretched arms, making them visible to motorists. By simply moving their hands back to their handlebars, they enter navigation mode, which fluidly guides them through their route without the need to reach for their smartphone. By integrating gesture-invoked signaling and easy-to-use navigation into a smartwatch form-factor, Flare makes night-time riding a better experience