GloboBikes

Design Document

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Overview (Noah):

In the world of navigation, we often see that there are solutions out there for routing an individual from one location to another utilizing accurate estimated time of arrivals, traffic estimations, and road closure information. However, in the specific case of biking, obtaining accurate routes that for certain contain bike lanes, do not go against one way traffic, or have their bike lanes not obstructed by any of a multitude of potential reasons is not a common feature. Delivering a routing software that provides users with safe biking routes that are void of any obstructions in real time is a main purpose of GloboBikes - one that, through user supported reporting of hazards, could potentially give civilians more confidence in their ability to bike while also promoting community engagement in this more environmentally friendly solution to transportation.

Purposes of GloboBikes:

1. **<u>CONFIDENCE:</u> To give bikers the confidence that they can reach their destination safely.**
   We aim to give bikers 100% certainty that when they ride with GloboBikes, they will either encounter no hazards or obstructions in their journey or will find something that will better the safety of their fellow bikers. By introducing a system of user reports, users know they will avoid a vast majority of potential issues through the support from their community on this app. And, they will know that if they do encounter one they can report it and remove that hazard from the next user who may have needed to go through that area.
2. **<u>ALTERNATIVE ENCOURAGEMENT:</u> Help transition some people's main source of transportation from vehicle to bike.**
   Some people do not use bikes as their primary form of commuting, especially in cities, because of the potential safety issues of doing so. By carrying out GloboBike's first purpose above, we aim to reduce hesitations for biking that could potentially sway people towards choosing a bike rather than a car: promoting less traffic on roads, less pollution, and better overall health through more frequent exercise.
3. **<u>COMMUNITY:</u> Provide a more cohesive and supportive community around biking.**
   By instilling things such as badges for different fitness or biking achievements, a following concept amongst active users, and allowing users to publicize the routes they have taken, we hope that GloboBikes can help potentially make biking more of a social activity rather than just one for transportation.

The only similar app to GloboBikes that we are aware of was an app called *LaneSpotter*, which was removed from markets not because of design flaws but because of technical flaws. Looking at their design though regardless, one of the main deficiencies of LaneSpotter came from their authentication of data submitted by users - in this app, they said that they work with local cyclist groups to authenticate the reports they receive from users. We believe this was a major bottleneck as it limits the potential for how up to date their information is. Instead,

GloboBikes proposes a new system where users themselves authenticate reports made by other users, furthering the community engagement and trust that are two of the major pillars of the platform.

Another issue with applications like LaneSpotter is that they do not include the social features that are promoted in GloboBikes aside from the reports themselves. Thus, users are not encouraged to use the app aside from its routing and reporting services - in order to promote the shift to biking and develop a community about it, we developed the social aspects above.

Conceptual Design (Garrett):

Follow

Purpose: link a user to other users and neighborhoods to let them view associated reports and biking activity

State:
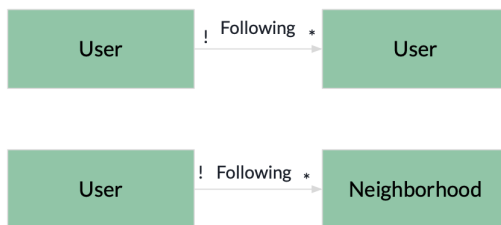
Actions:
follow(user1: User, user2: User):
        add user2 to user1.following;

unfollow(user1: User, user2: User):
        remove user2 from user1.following;

follow(user: User, neighborhood: Neighborhood):
        add neighborhood to user.following;

unfollow(user: User, neighborhood:Neighborhood):
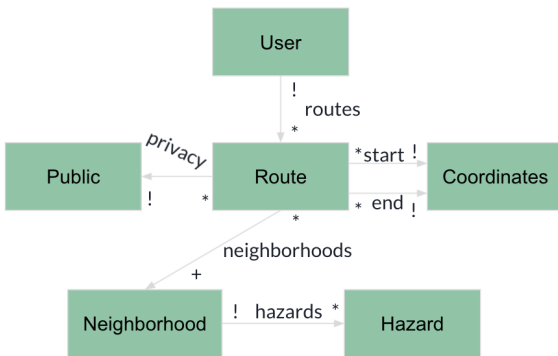   remove neighborhood from user.following;

Operational Principle:
u1: user1, u2: user2, n: neighborhood
1) follow(u1, u2) => u1 follows u2; unfollow(u1, u2) => u1 does not follow u2 anymore;
2) follow(u1, n) => u1 follows n; unfollow(u1, n) => u1 does not follow n anymore;

Route

Purpose: guide users safely from one destination to another and share ride info with followers

State:

Actions:
createRoute(user: User, start: Coordinate, end: Coordinate):
    route = new Route;
    add route to user.routes;
    route.start = start;
    route.end = end;
    route.neighborhoods = neighborhood(s) contained in start + end coordinates;
    return route;

deleteRoute(user: User, route: Route):
    if route exists and route in user.routes:
        remove route and remove from user.routes;

publicize(route: Route, toPublicize: Boolean):
    route.privacy = toPublicize;
    return route.privacy;

saveRoute(route: Route, user:User):
    add route to user.routes;
    return route;

operational principle:
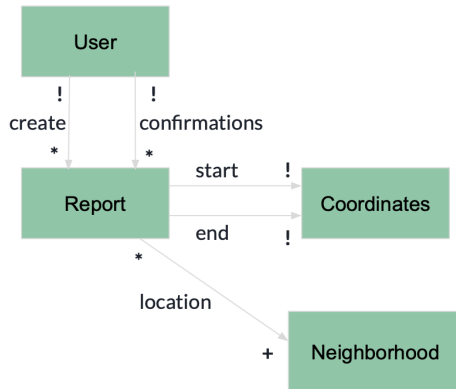u1: user1, u2: user2, s: start coordinate, e: end coordinate, r: route
createRoute(u1, s, e) => r; publicize(r, true) => true; saveRoute(r, u2) => r is saved;
    1) createRoute(u1, s, e) => r; publicize(r, false) => false; saveRoute(r, u2) => r is not saveable;
    2) createRoute(u1, s, e) => r; deleteRoute(u1, route) => r does not exist anymore;

Report

Purpose: identify where there are any blockages or obstructions in streets and bike paths

State:

Actions:
createReport(user: User, start: Coordinate, end: Coordinate):
      report = new Report;
      add report to user.create;
      report.start = start;
      report.end = end;
      report.location = neighborhood which Coordinates (start, end) is in the world
      return report

deleteReport(user: User, report: Report):
      if report exists and report in user.create:
            remove report and remove from user.create

confirmReport(user: User, report: Report):
      if report exists and report not in user.create:
            user.confirmations = report

numberOfConfirmations(report: Report):
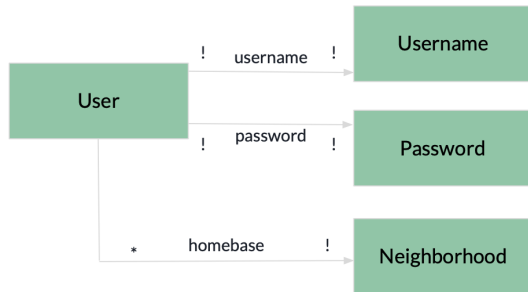   return sum of list confirmations.report

Operational Principle:
u1: user1, u2: user2, s: start coordinate, e: end coordinate, r: report
    3) createReport(u1, s, e) => r; confirmReport(u2, r); numberOfConfirmations(r) = 1;
    4) createReport(u1, s, e) => r; deleteReport(u1, r) => r does not exist anymore;

User

Purpose: generate accounts and grant ability to maneuver full capabilities of app

State:

Actions:

createUser(username: String, password: String, neighborhood: String):
      user = new User;
      user.username = username;
      user.password = password;
      user.homebase = neighborhood;
      return user;

deleteUser(user: User):
      if user exists:
            delete user;

updateUsername(user: User, newUsername: String):
      if user exists and newUsername does not exist;
            user.username = newUsername;
      return user;

updatePassword(user: User, newPassword: String):
      if user exists and user.password != newPassword:
            user.password = newPassword
      return user;

updateNeighborhood(user: User, newNeighborhood: String):
      if user exists and user.homebase != newNeighborhood:
            user.homebase = newNeighborhood;
      return user;

Operational Principle:

u1: user1, p: password, n: username, h: neighborhood, p': password 2, n': username 2, h': neighborhood 2

1) createUser(n, p, h) => u1; updateUsername(u1, n') => u1 with new username;
2) createUser(n, p, h) => u1; updatePassword(u1, p') => u1 with new password;
3) createUser(n, p, h) => u1; updateNeighborhood(u1, h') => u1 with new homebase;
4) createUser(n, p, h) => u1; deleteUser(n, p) => u1 does not exist anymore;

Sketches (Noah):

A user can only access features of the app by creating an account. This is done on the authentication page, which is standard except the user must also give their address / neighborhood when signing up:

Following signing up, the user will be taken to the homepage, which will only be populated with reports that they can interact with until they have their own rides / add friends. Assuming the user has already done this, we get a homepage like this:

By clicking hazards on the left side navbar, it takes a user to the hazards page, which first displays all of the currently open (not confirmed yet) reports for the user's given neighborhood:
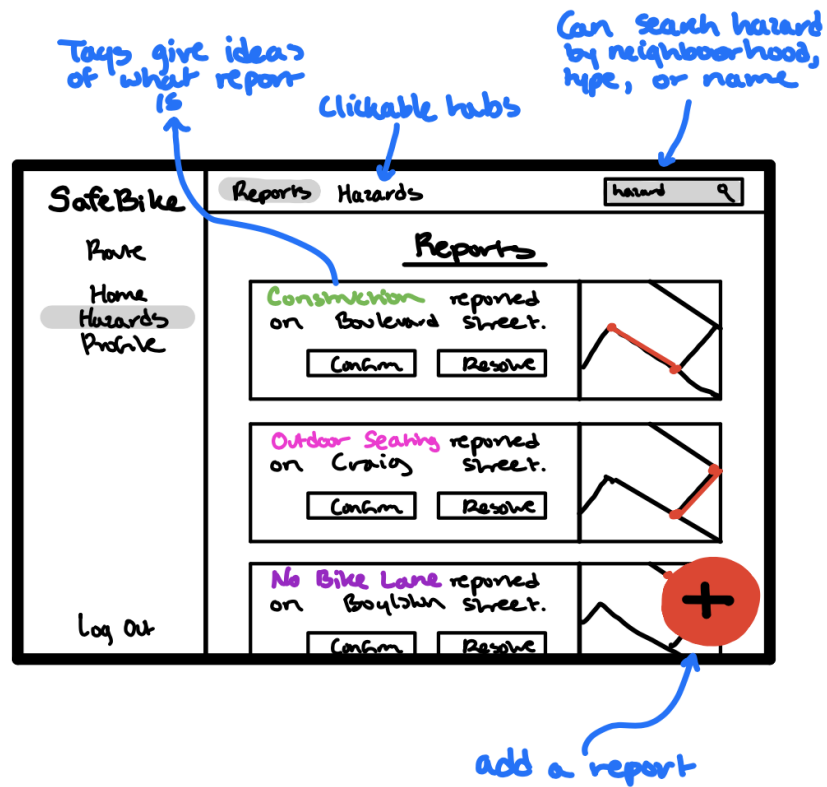
Here, a user can also click the red "+" widget to add a report:
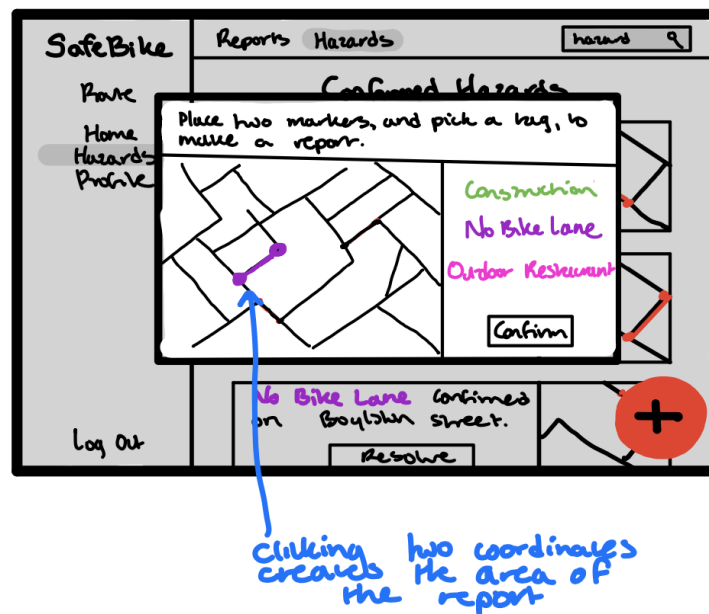
Upon confirming or closing out, we return to the hazards page, and by clicking hazards on the top navbar, we reach the confirmed hazards page - ones that have already met our threshold and that we know are real reports:
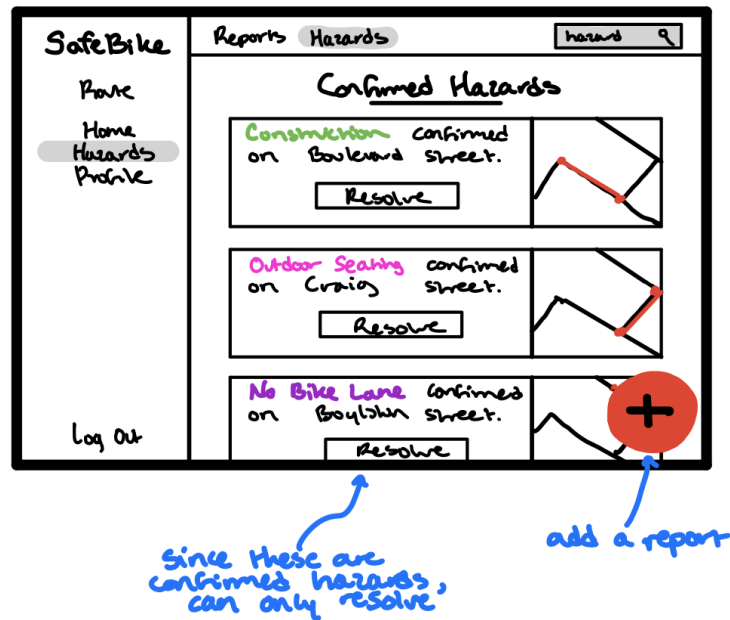
By clicking route, we get to the main part of our app: the routing software that avoids hazards:
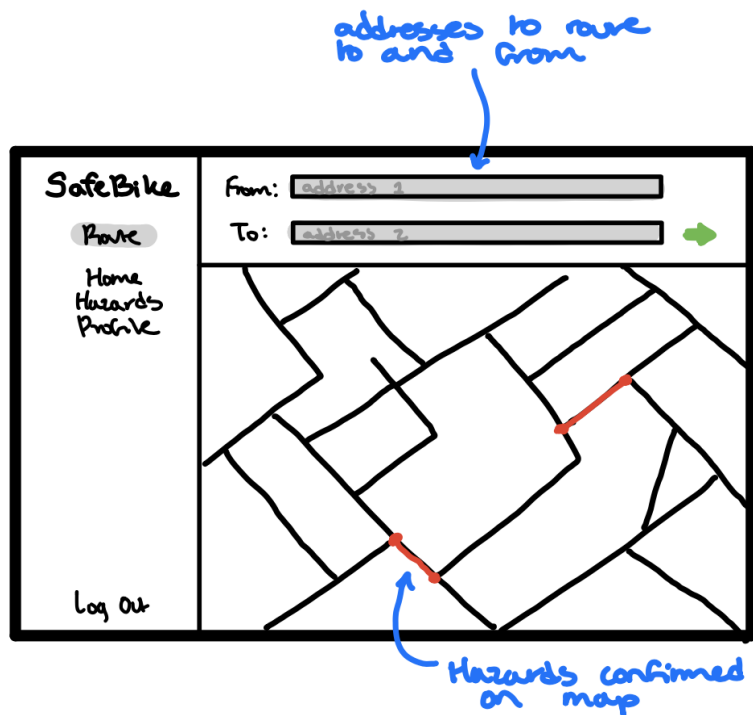
By clicking go, it will then give a map of the route that is best to take. Now, we can go to the profile page by clicking "Profile" on the left side navbar. What initially shows are both your routes you have taken and those saved from your friends:
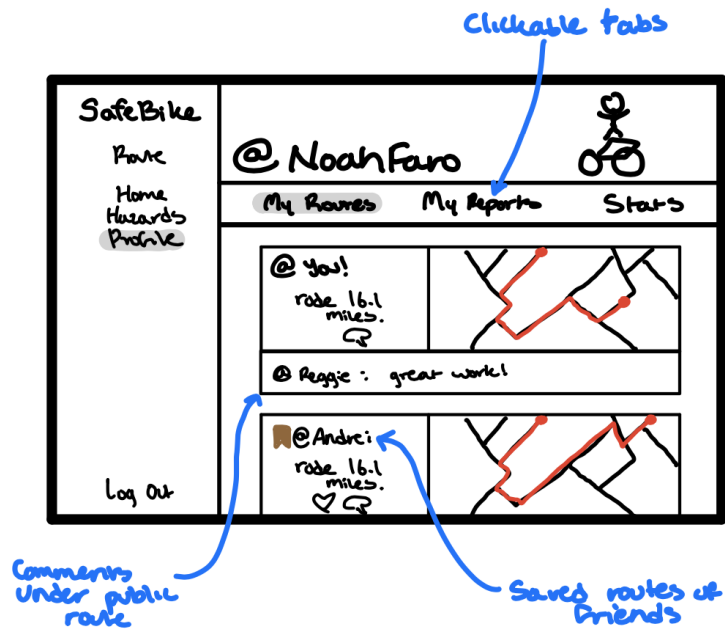
Next, by clicking "My Reports" in the profile tab, you can then see the reports that you have created, and choose to resolve them if they have been cleaned up:
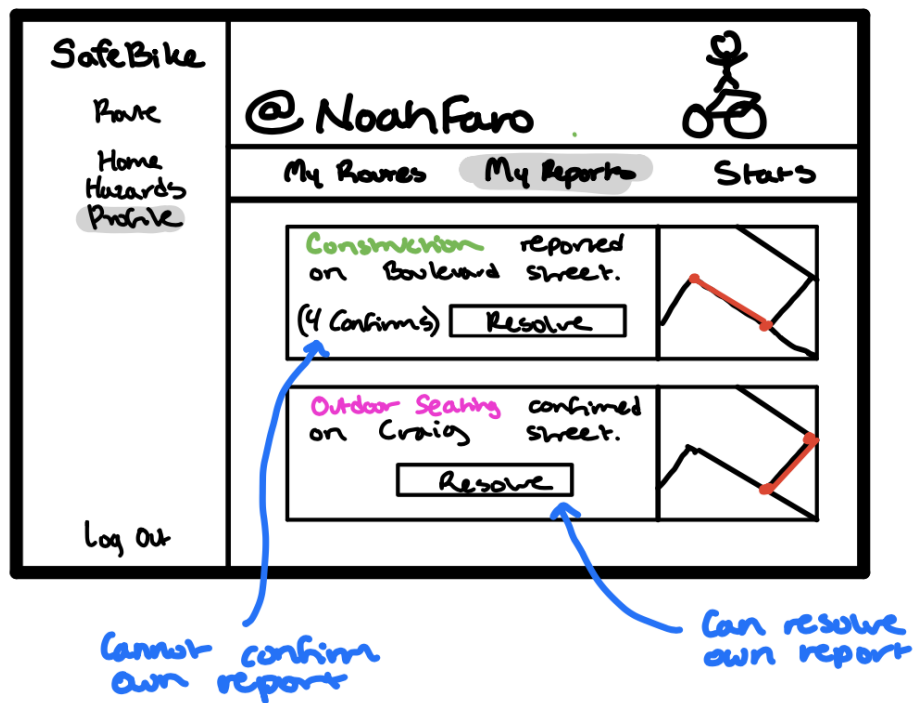
Lastly, you can click the "Stats" tab in the profile navbar to see your individual stats as a user of our platform:

Badges

SafeBike

Route

Home
Hazards
Profile

@ NoahFaro

My Routes   My Reports   Stats

★
10 mile
ride

500 total
miles

5 Reports
Made

Miles
763 mi

Longest
21.3 mi

Reports
7

Log Out

Statistics
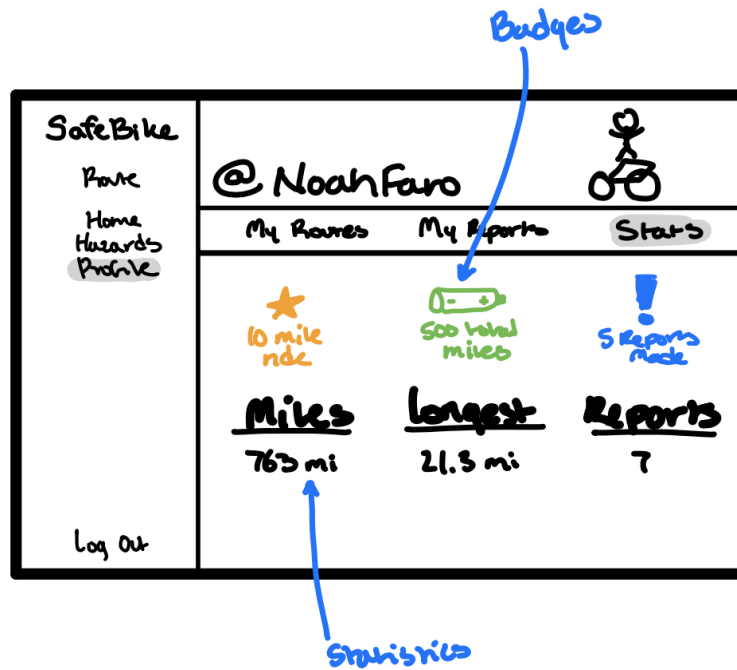
Design Commentary (Andrei):

1. Encouraging Users to Actual Report and Confirm Hazards

At the essence of our app, GloboBikes is aiming to improve community engagement and to allow bike riders to find easier and alternative bike routes to help out with their everyday commute. Without buy in from the community, this app will not work since there will not be enough users reporting blockages and hazards and such. So, in order to ensure that we have users engaged with our app and reporting hazards as the app was intended to be used, we have made several major design choices.

Options Considered:

1.) **Award Badges to Users for Various Accomplishments.**

The first and most relevant choice that we considered making was to add a badge system to our application. By this we mean, whenever users reach a specific milestone, for example biking their first 10 miles, or reporting their first hazard, then there would be a badge for this showing up on the user's profile. This idea is similar to some functionality on the running app strava. The main purpose of these badges is to get the users excited about their progress and to invite more desire to achieve these badges and therefore engage with the app more often. We are planning for these badges to show up on the home feed as well for users to like and comment on their friends progress. These badges will not only work for achievements of mileage, but also for those of reporting and confirming hazards or delays, which we think is enough to encourage users to actively report and participate in the community of bikers in the neighborhood.

2.) **Reports Shown On The Home Feed**

One interesting option considered when discussing how to invite more engagement was to include all of the reports around the neighborhood of the user directly in the home page and directly in the same feed as the routes of users that the current user is following. In discussing this, we discussed how twitter organized its home page to show its users their following tweets and retweets and liked tweets etc. Twitter has most of their functionality and user interaction directly on the home page. When discussing this, we agreed that a timeline that looks like this is beneficial for making the app as easy and least frustrating as possible. Users do not have to switch between multiple tabs and multiple pages in order to find the report button, they simply go to the home page and are able to confirm or deny reports on the spot. This also leads into our overall goal of community engagement as users will be more likely to confirm a report if they do not have to go hunting for them, and they instead just showed up in front of them. All of these factors combine to make it a very useful and powerful design choice.

3.) **Exclusive Page for reports**

The third and last possible design choice we discussed as a team when talking about increasing community engagement and encouraging users to report was to just have an exclusive page dedicated to reports and not have reports show up anywhere else. This is a much more formal and logical approach than the second one we discussed, and it adds a lot more weight to the hazards. This approach makes sure that users know the one place to go when thinking about reports and hazards. Having one such location that is always in the same spot is reliable and easy for users to interact with, however the problem with this approach is that it provides no motivation for the user to actually report. It requires more effort and is less appealing of a timeline overall which discourages users from interacting with the tab.

Design Decision

We Ultimately decided to go with a design that reflects a combination of the first and second option discussed in this section. We will have badges for achievements of the users, and we will also include reports on the home feed for users to see more easily. We ultimately decided to go with this approach and not the more formal and traditional route of the third approach we discussed in this section because in order for our app to truly succeed, we need as much user engagement and as much incentive for users to report hazards and confirm hazards as possible. A combination of the first and third approach provides that for us.

2. How Reports are Authenticated

When talking about our report system, we wanted to really discuss how we could stand out and make sure that reports are not false and made as jokes by random strangers trying to be funny. Our main goal for this app is to promote engagement from the surrounding community and in order to do that we must ensure that our report system does not just rely on good citizens to work, but is implemented in a way that is smarter and less affected by singular joke reports. As a result, we discussed several different choices we could make in order to ensure the accuracy of our reports.

Options Considered:

1.) **Reports Must Be Verified**
The very first idea that was brought up amongst our group was to have a system where a report could be made, and initially this report would show up as unconfirmed, but it would still show up in the timelines. From there, in order to be confirmed, a second user would have to approve the report. Now this is basically just like 2 step verification, it simply adds a second layer of certainty to help ensure that the reports are not false or wrong, but helpful and accurate. Once a report has been confirmed, then we allow users to settle the report (make the report go away as it is no longer relevant). The main drawback to this approach is that we must solve the problem of engagement and ensure

that users are active enough to want to actually confirm other people's hazards and reports. How we achieved this is explained in our first design choice however.

2.) Karma Scores

As we talked about in the introduction to this specific design choice, reports must be verified in some manner in order to ensure that fake reports or inaccurate ones affect the greater community. For this specific approach, we talked more about how to incentivize bad behavior and instead make the users want to be accurate with their reports. To do this, we discussed introducing a karma score for each user. Whenever they like or comment on some route they get increased karma, whenever they confirm a route, the user gets increased karma, when they have a hazard denied their karma score will go down etc. This approach was taken from yik yak, an anonymous message board app that had a history of heinous behaviors on their app and fixed it with this karma system. We talked about how to take it further as well. If a user is above a certain karma level, then their reports are automatically confirmed and do not need a verification. On the other side of this, if a user has a low enough karma score, then they will not have the option to even create reports.

3.) No Confirmation Needed

The last approach we discussed when thinking about this overall design was to simply not have any reports that need verification and instead show everything that users report automatically as accurate and true. This really does not offer any protection or fact checking at all, which is why we did not opt for this design approach.

Design Choice:

For the question of how we ensure that our reports are accurate and beneficial to the community, we ended up choosing the first approach. We feel that on its own, a two step verification should be enough to not only ensure the validity of the hazards, but discourage users from making false reports as well. The karma approach to us was a very interesting and unique approach, but we feel that it is out of place on this app, and we simply want the user to have the best experience possible. The first approach we discussed achieves this for us, and that is why we ultimately went with a two step verification for our reports.

3. Level of Privacy Supported By Platform

There are a multitude of different things that we need to consider when trying to support the privacy of our users. Whether that be how much information they give to sign

in, how much of their routes they are sharing with their friends, or whether or not their reports are anonymized, these are all privacy issues that we must investigate to make our design optimal.

<u>Options Considered:</u>

1.) **Full Privacy**

      In this scenario, we attempt to maximize the level of privacy and anonymity of the user. This means that upon signing up, we are only given the neighborhood that they live in rather than their exact home address - promoting the first level of privacy between the user and the platform itself. Next we would also make nearly all parts of a user's profile private until they are added as a mutual friend, perhaps the only public component being their stats prior to that. We must also consider what is shown for a report, which must be in the public domain as all users in the area must have the ability to confirm or deny their legitimacy. In this option, we make all reports anonymous to everyone except the user who created them so that no person is publicly commented on for their reports. The last part that we must initially consider is how to prevent users from releasing too much of their information to their followers. This is going to be done by setting completed route sharing to "private" by default, meaning that users will have to manually change their route to public each time they want to share it with their friends. All of these considerations do the absolute best to manage a person's information and limit it to be as anonymous as possible unless otherwise designated by the user.

2.) **Looser Privacy**

      With this, we take a less decisive stance on privacy and allow a little more freedom and discovery for our users. Similar to the previous option, users only sign up with their neighborhood. Unlike the previous option however, a user's public routes are public to everyone that looks them up, and a user's report is not anonymous. It is possible that the former is not an issue, as allowing users to designate which routes they want public versus private would mean that they would be just more selective with their routes; and the latter may not be a problem either if people are sending reliable reports. Lastly, again routes would be defaulted to "private" in order to decrease the potential of accidental important data slippage.

3.) **No Privacy Considerations**

      In this option, we take an approach with little to no decisions that weigh privacy, prioritizing the social aspects of the platform. When users sign up, they will give the address of their home rather than their neighborhood, allowing us to have a quick address of home and also know which neighborhood they are in from it. Similar to the looser privacy option, we would make a user's routes public to everyone while also making reports non-anonymous as well. Lastly, we would set the default sharing option for routes to be "public" rather than "private" in order to best support the connectedness of our users.

We believe that the utmost privacy option is the one that is the best solution for our platform. So much of GloboBikes revolves around addresses, locations, and routes, and we think that one of the worst case scenarios of our platform is that a user's routines or location is leaked to the public and there are actual dangers resulting from that. As such, we think that limiting this possibility is the best course of action - the only time that any route information or location information is public is when the user specifically decides to take the action to make a route public. Aside from that, users can stay completely separated from the rest of the users, which is important given the very severe societal implications potentially at play if we did not do this. A good example is that if a report was not anonymous, another user could figure out what neighborhood is near the user that reported it, which is a clear breach in privacy.

4. Reporting of Specific Areas of Roads

Looking at the potential different hazards in terms of their geographic radius, any could be as long as a mile for road construction or as short as twenty feet if someone has an outdoor restaurant. As such, we want to make sure that our reporting process is seamless as this would remove potential barriers that prevent users from consistently reporting issues.

<u>Options Considered:</u>

1.) **Setting Range with Two Addresses**
This seems like the obvious method of potentially setting a specific area of the road that has a hazard on it for bikers. Knowing two addresses makes the tracing of the path of the hazard easy, but it does also require the users to know two different addresses, even if they are super far apart from each other (take the one mile radius example). In essence, this option would create a route between the two addresses, then mark that as whatever hazard the user declared it to be.

2.) **Setting the Range with Nearest Addresses to Clicked Coordinates**
This is a much less straightforward option for how we decide to set the range of the hazards. In this option, users will click the general range of the hazard - meaning that they will be eyeballing where it starts and where it ends rather than typing in a specific address. Then, we will again find the shortest route between the two points, and mark that as the zone with the hazard. What this does is alleviate the need to know specific addresses in terms of the start and end areas of the hazard, potentially increasing ease of use.

<u>Design Decision:</u>

We believe that the second option is the best solution to the potentially complicated problem of determining the start and end points of a reported hazard. There

are two main trade-offs that were considered that led to our decision: ease of use for the user, and accuracy of the reports. We figure that in regards to ease of use, clicking a map is much quicker than typing in an address, and also requires less information as knowing the two addresses may require the user to visit both sides of the reported area. In terms of accuracy of the ranges, we attempted to understand the potential for error that results from an inaccuracy, and found that slight deviations in clicks likely do not result in large issues in terms of routing. For example, if a range is slightly larger in the platform than its actual size on a given road, GloboBikes will end up not using that section of the road for routing anyways. Thus, we prioritized ease of use for our consideration, and as such chose the second option to be our solution.

Ethics Protocol Analysis (Reginald):

Envisioning Futures:

1) *What is a best case scenario for the outcome of your project?* We hope that bikers in major cities, and any populated suburban area are able to find safe and fast routes for their commutes. Users will help other users by reporting which roads don't have safe bike lanes and where there are obstructions such as traffic. Users will see other users' popular routes to find better ways to travel. The app is welcoming for users to follow

others to find these routes and build a community of people who want to create greener travel.

2) *What is a worst case scenario for the outcome of your project?* It could turn out that users don't build community on the app. They create fake reports to steer other bikers from their path to keep them away. They could also clutter the app with reports and confirmations that are useless and causing longer load times for other user's routing. There are people who may follow others just to get insight where they typically are biking to and from. There is also the scenario where no users make reports or do any confirmations, so the user feedback isn't being factored into routes. This can make the app seem like it's not doing its promise of finding safe and fast routes, so quickly users stop relying on it. Users also may not publicize their routes, meaning the following and community aspect of the app deteriorate.

3) *If your project were featured in an episode of [Black Mirror](), what would happen in it?* If this app were included in a Black Mirror episode, it would be titled: "Biker Vision". The premise would be that this app is really popular in the city that's the setting of the show. It's a super green place since no one really uses cars and bike lanes are constantly being improved to encourage biking. We'd follow one user who is an influencer of the app as his bike paths are genius and innovative, creating new ways for people to travel across the city since they save his rides. Someone would abuse this and begin to track where he is from. They would predict where he would try to bike next based off of this information, and start to leave threats for him. This would scare the person, but as the evil person gets closer to making a malicious move, they eventually would get caught. This is a happy ending for the influencer, but people stop using the app.

Potential Stakeholders:

- Bikers
- Commuters
- People concerned about traffic delays
- People concerned about dangerous/high-crime areas
- Tourists
- City Planners
- Real Estate Developers
- Delivery Services
- Businesses next to bike paths
- People in population-dense areas
- People in rural areas
- Neighborhood members concerned about traffic
- Ride sharing services and their drivers
- People with and without smartphones
- City public transit
- Gas stations

- Bike Shops
- Families with children who play in the street in typically low traffic neighborhoods

Value-Laden Design Decisions:

Possible Choice	Values promoted (and for whom?)	Values demoted (and for whom?)
Allow users to publicize their previous routes taken to all users	**Process:** users can choose and know that their routes are available to all of the users **Structure:** users can get better routes to take around the city looking at other's routes	**Outcome:** users' privacy may be breached and other users can maliciously use data to find where they live, work, etc.
Don't allow users to publicize their previous routes taken	**Structure:** users are all treated the same as their routes aren't shown to others **Outcome:** users' privacy is certainly more secure as they can't be tracked by others easily	**Process:** it's less transparent what saved route data is being used for **Structure:** users can't see better routes so they end up only taking the routes that app gives them an another user may get better routes
Allow users to publicize their previous routes taken to just followers	**Process:** users can choose and know that their routes are available to their followers	**Structure:** only some users get the better routes because you have to follow users to view routes others are taking **Outcome:** user's can still have malicious followers that can try to find where they live, work, etc.
Allow users to publicize their previous routes taken to just mutual followers	**Process:** users can choose and know that their routes are available to their mutual followers **Outcome:** users will less likely deal with malicious actors since they share with people who they trust more as mutual followers	**Structure:** users can't see better routes if they don't have in person friends on this app and can't find friends on this app who'll follow them back to share routes, so limits the community aspect

Possible Choice	Values promoted (and for whom?)	Values demoted (and for whom?)
Require a fixed number of confirms or denies to assess a report's validity	**Outcome:** The system will be simpler in confirming/denying structure **Structure:** Users in population-dense areas will receive quick and highly-trustworthy reports	**Structure:** People in rural areas will likely have reports take longer to be confirmed given lower population density and thus less users
Require reports to be confirmed by a certain percentage of a certain amount of confirm/deny votes	**Outcome:** Users can be highly confident in the reports of other users as they've been confirmed by a reasonable amount of other users. **Structure:** People concerned about traffic may be particularly affected by this as they may not hear about traffic delays until it is too late because not enough users had reported the delay.	**Process:** This would make the process for eyewitnesses to report something more frustrating. Because their report is not instantly confirmed they may worry that the report is not able to help people in time, especially if it is highly sensitive.
Confirm any report then remove it if a certain amount of people deny	**Outcome:** Users in general are the most informed, although some of the reports could be made by bad actors and could be incorrect. **Process:** Users will feel instantly heard when they post a report as it will immediately display in the feeds of others, improving the process for making reports.	**Outcome:** A confirmed report that is incorrect could negatively impact someone's travel time **Structure:** Users such as commuters and people concerned about safety/high-crime areas will be affected disproportionately as commuters can have their commute times negatively impacted by non-existent hazards. People concerned about dangerous areas could get re-routed through dicey areas as a result of non-existent hazards.

Possible Choice	Values promoted (and for whom?)	Values demoted (and for whom?)
Allow users to make reports of blockages or lack or bike paths	**Process:** everyone can participate in making the reports and its transparent are reports are shared to all users **Outcome:** there are better and safer paths for the users to bike along as the routing takes into account these blockages	**Outcome:** there may be neighborhoods that have increased traffic as a bunch of bikers take obscure paths through their streets and sidewalks because of various reports **Structure:** there are stakeholders who are not on the app who get less traffic at their stores or place of business as reports cause bikers to avoid them and this can become an issue if this is absused
Don't allow users to make reports	**Structure:** all of the users have to potentially deal with getting safer routes from the map api which knows about car traffic or construction; no businesses or shops are avoided due to the app avoiding them from users maliciously creating reports	**Process:** the users don't necessarily know why certain routes are chosen because reports aren't displayed why their normal path is blocked up **Outcome:** there are worse routes being offered to users because the routes aren't necessarily safer, but they may just be the fastest
Allow only verified users to make reports	**Process:** all of the users know that the reports come from trusted members of their community and people who use the app a lot, meaning they most likely have the best intentions to promote the app's usefulness and make reports when needed	**Structure:** only some users get to be involved in the report process so many things can get missed when users who aren't verified yet are unable to make these reports **Outcome:** there are less reports on the app giving everyone worse routes overall until enough people are verified to make reports, but there may be missed window to get the app popular to use

Justification:

1) **Route Visibility:** We chose to allow users to post their routes to just mutual followers. If we had opened it up to all users there would be serious safety concerns because bad

actors could potentially find a user and track their routes to see their typical biking habits. This could create a dangerous atmosphere for the app which we must avoid. Not allowing users to view other routes at all would seriously limit the use of the app. Adding the sharing of routes and liking and commenting on them between friends adds a fun, social element to the app that we decided was a priority to include. It will be stated to users that their mutual followers will be able to view their routes, so they are aware of the risks of following others.

2) **Confirming/Denying of Reports:** We chose to require reports to have a fixed number of confirmations to be valid and a certain number of denies to become invalid. This is the simplest way to be fair to people in high density areas where a report hits a minimum threshold to be useful in accounting for routes whereas using a ratio of confirms/denies and the plain just deny option don't give any confirmation that a report is true. The users are also more involved in this system and it's transparent how true a report is to the user base when there is a minimum. We didn't go with the ratio because it could cause a delay in the report to confirmation that would make the report go useless. We didn't go with confirming any report because this is only positive feedback on the report system, and this could negatively affect certain stakeholders from high dense areas or less safe communities; they are routed through areas with a ton of false or overblown reports.

3) **Allow All Users to Make Reports:** We chose for all users to be able to make reports on the app. This is the backbone of making our app an improvement on other route making apps. In the context of bikes, this is especially important to make the routes applicable for bike routes and paths. The users can make reports to inform the app and other users where it is unsafe to bike currently with some obstruction and all time as there are roads without bike paths or sidewalks. The other options included no reports which then made the app rely on just the map api feedback on traffic and knowing if there is a bike path to make the routing decisions. Even if this helped with traffic in some neighborhoods and some businesses, this hurt all of the users of the app. The verified users option was a good one to limit any false or abusive reporting; however, the lack of number of reporters diminishes the value of it for rerouting and causes users to feel not as important for providing good paths for other users. It was best to choose the report option to get all users involved.