BLUEMäps
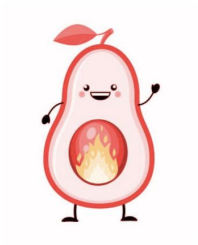
Project Design

Spicy Avocado

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Brief description of system to be built:

We are building a travel planner app that helps users plan trips and routes to take when riding Blue Bikes (via walking + biking). Our planning service will provide estimated travel times. Users will be able to create accounts on our service and save their favorite trips so that they can access it in the future without reentering starting and ending locations information.

Key purposes:

- Improve pre-existing Map apps
  - Summary: Provide multiple transportation options for users that pre-existing Map apps don't have.
  - Description: Current maps are limited to showing trips using only one type of transportation to get users to their requested endpoint. Users cannot be flexible in their transportation methods because if they wanted to both walk and bike to their destination, there is no such option in pre-existing apps. Our purpose is to improve upon this flaw in our app and allow users to plan trips that involve both walking and biking.
- Make Boston traveling easier
  - Summary: Make traveling in Boston easier by making travel planning with Blue Bikes easier.
  - Description: Blue Bikes were made to give Bostonians another, easier, and more convenient way to travel. However, the current Blue Bikes app does not give users a way to easily plan their trip from one location to another. As a result, we are developing our app to make usage of Blue Bikes more convenient, and therefore make traveling easier for Boston residents.
- Help the environment
  - Summary: If more people biked/walked to places instead of driving or riding Lyft / Uber, then there will be less carbon emissions.
  - Description: Boston has a lot of cars and they produce a lot of carbon emissions. In fact, in 2017, the Boston community emitted 6.1 million metric tons of greenhouse gases, which is equivalent to 1,295,117 passenger vehicles driven for 1 year. By providing an easier way to plan travel with walking/biking, we can reduce the amount of car trips made and therefore reduce carbon emissions.
- Save people money
  - Summary: Travel options like walking and biking with Blue Bikes are cheaper than Uber/Lyft and owning a car
  - Description: Using a shared ride service like Uber or Lyft to get from one point to another in the city can be both costly and time-consuming, especially during rush hours. On the other hand, a combination of walking to and from dock stations and biking between dock stations using a Blue Bike that costs $2.50 per 30 minutes will definitely be less expensive, and might even be more time effective depending on traffic and where people want to go.
- Promote shared public transportation options
  - Summary: Promoting Blue Bikes means that we're promoting shared public transportation options.
  - Description: By making Blue Bikes more convenient to use, more companies may be incentivized to create public transportation options after seeing the success of Blue

Bikes which will improve the quality of life of Bostonians by providing more shared public transportation options in the future.
- Trip Time Estimator
  - Summary: Give users a more accurate idea of how long a trip takes.
  - Description: Provide a trip time estimator for trips that combine both biking and walking routes. Our app will give users an estimated time that takes into account the following information: walking, biking, and waiting time at the docks and other stops along the trip.

Deficiencies of existing solutions (if they exist, and if not, why you suspect not)"
- Google Maps does not currently incorporate Blue Bikes into its transportation options.
  - Google Maps is used all over the world, so they are not specialized to any specific region and do not cater to local transportation options (for the most part)
  - Being able to create an app that is specific to the greater Boston area is a strength since it allows us to cater to the needs/requirements of the people here using Blue Bikes
- Blue Bikes app currently allows users to favorite docks, but they do not have the concept of a trip, so users cannot save their favorite trips and instead have to re-enter the starting and ending locations of a trip every time in order to plan traveling with a Blue Bike.
  - Blue Maps will personalize trips so that users can create accounts and save trip information for future use

Conceptual Design (Robert)

1. **Trip**
   - **Purpose**: Provides a way for users to plan in distance and in time their entire journey, using different modes of transportation to get from one point to another.
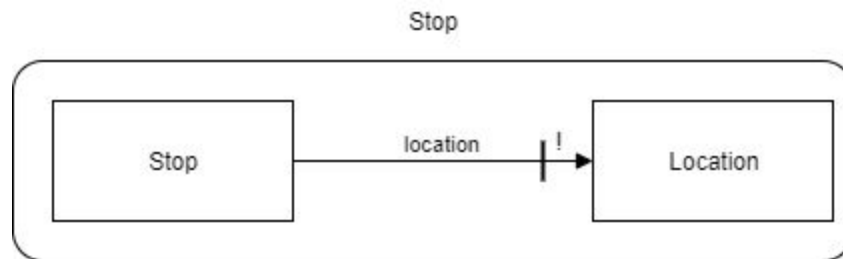   - **Structure**:
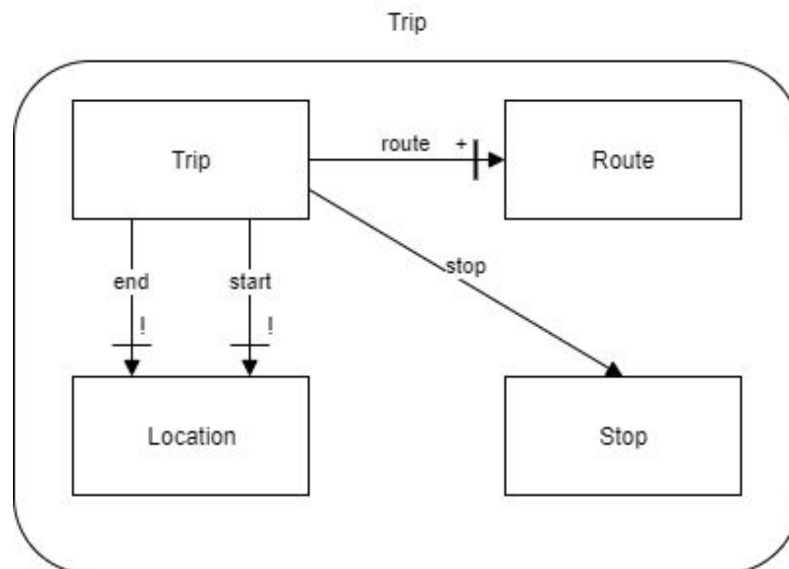
   - **Behavior**:
     - **create(r: Route[], s: Stop[], out t: Trip):** Creates a trip given an ordered sequence of the routes and the stops of this trip. The trip consists of the routes in the order given, and of the stops between each route in the order given.

- ○ **delete(t: Trip):** Deletes the given trip if and only if the given trip has been created and still exists
  - ○ **getDuration(t: Trip, out d: Duration):** Finds the duration of the given trip, found as the sum of the durations of the routes and stops of this trip.
  - ○ **getStart(t: Trip, out s: Location):** Finds the start location of the given trip, found as the start location of the very first route of this trip
  - ○ **getEnd(t: Trip, out e: Location):** Finds the end location of the given trip, found as the end location of the very last route of this trip
  - ○ **getRoutes(t: Trip, out r: Route[]):** Finds an ordered sequence of all of the routes for the given trip
  - ○ **getStops(t: Trip, out s: Stop[]):** Finds an ordered sequence of all of the stops for the given trip
- ● **Tactic**: If a trip is created and not deleted, then we can obtain the necessary routes and stops required and the expected time the total trip takes to go from start to end.

2. **Stop**
   - ● **Purpose**: Distinguishes two different routes of a total trip, and allows users to know how much time they need to wait between routes

   - ● **Structure**:
   - ● **Behavior**:
     - ○ **create(l: Location, out s: Stop):** Creates a stop given a location l. The stop's corresponding location cannot be changed once it is initialized.
     - ○ **show(s: Stop, out l: Location):** Shows the location of the stop.
   - ● **Tactic**: If a stop is created and not deleted, it can be used to detect the time a user will have to stay waiting after finishing one route and before starting the next

3. **Account**
   - ● **Purpose**: Allows users to save favorite trips for easy access and selection in the future
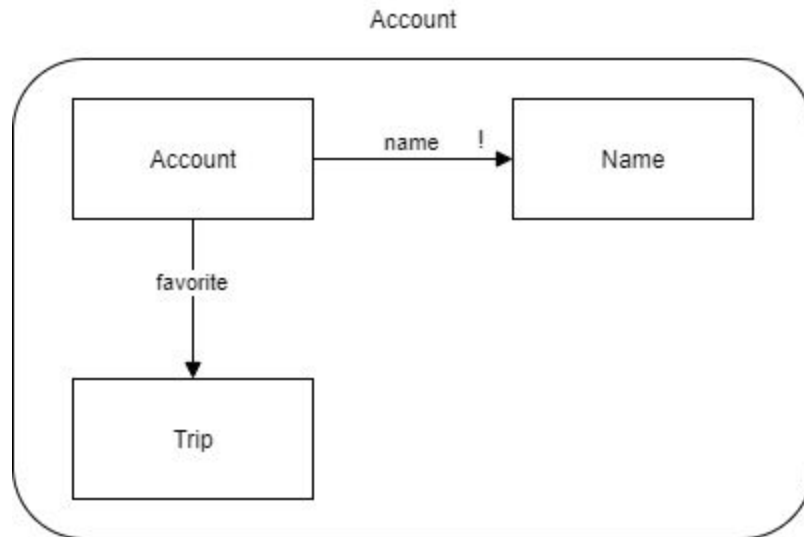
Account

- **Structure**:
- **Behavior**:
  - **create(u: String, out a: Account):** Creates an account if and only if an account with username u doesn't already exist.
  - **saveTrip(t: Trip, a: Account):** Adds Trip t to the list of Account a's saved trips.
  - **removeTripFromFavorites(t: Trip, a: Account):**Removes Trip t from the list of Account a's saved trips if t exists.
  - **getFavoriteTrips(a: Account, out t: Trip[]):** Shows the list of Account a's saved trips.
  - **delete(a: Account):** Removes Account a from the BlueMaps system.
- **Tactic**: If an account is created, not deleted, users of the app can add a trip if it doesn't already exist and delete any pre-existing trips from the account to save their favorite trips.

4. **Duration**
   - **Purpose**: Quantifies how long each component of a trip will take.
   - **Structure**:
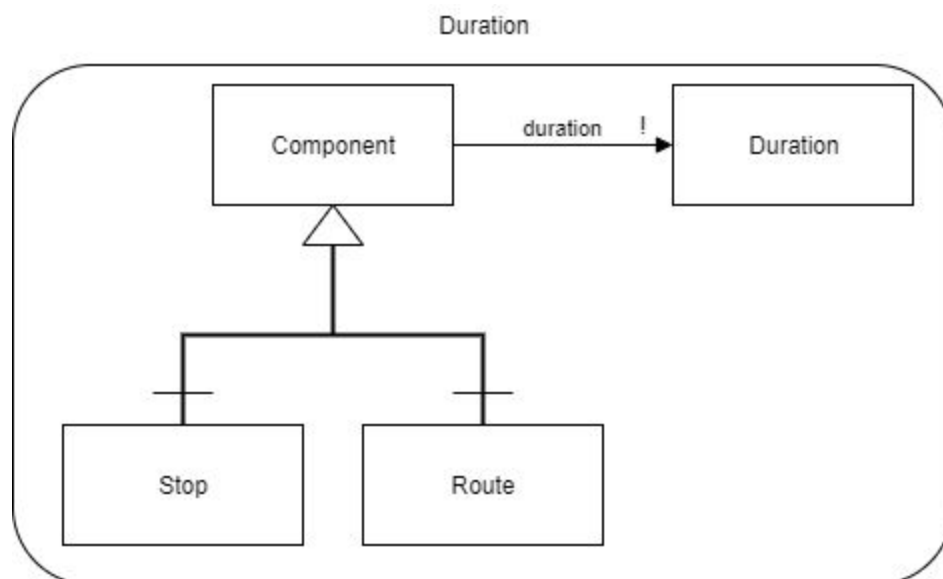
Duration

- **Behavior**:
  - **create(t: number, out d: Duration):** Creates a Duration d given a number t, representing the units of time of the duration. t must be > 0.
  - **show(d: Duration, out t: number):** Shows t, the units of time a Duration d takes.
  - **getWaitDuration(c: Component, out d: Duration):** Given a component c (either a Stop or a Route), shows the Duration d of that component.
  - **delete(d: Duration):** Deletes the given Duration d if it exists.
- **Tactic**: If a duration is created and not deleted, then the number of seconds of it can be obtained to show how long it will take

Wireframes (Steven)

Now, we go through the potential flow of the website with some wireframes. First, the user enters the website, but they have not logged in or created an account yet. In this case, they are greeted with this landing page:
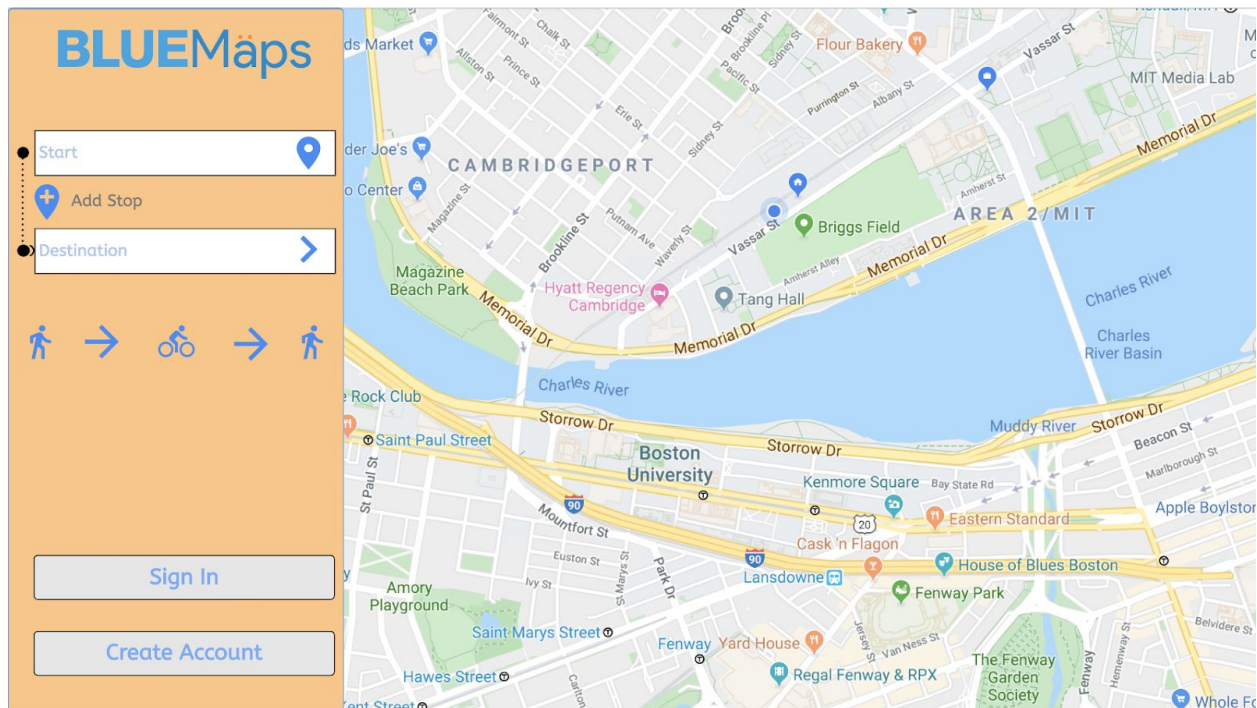

From here, they can specify the Start and Destination locations of a possible tip. If they want to use their current location as the trip's Start, they can click on the location icon in the text field for the Start location. Also, they can add stops to their trip by clicking on the location icon with a plus. These stops will be placed in between the Start and Destination locations. Finally, the user can click the blue arrow in the Destination text field to start their trip once they have given Start and Destination locations. Let's say the user enters uses their current location (Simmons Hall) as the Start location, and enters MIT Media Lab as their Destination. Then, they click the blue arrow. The page changes to:
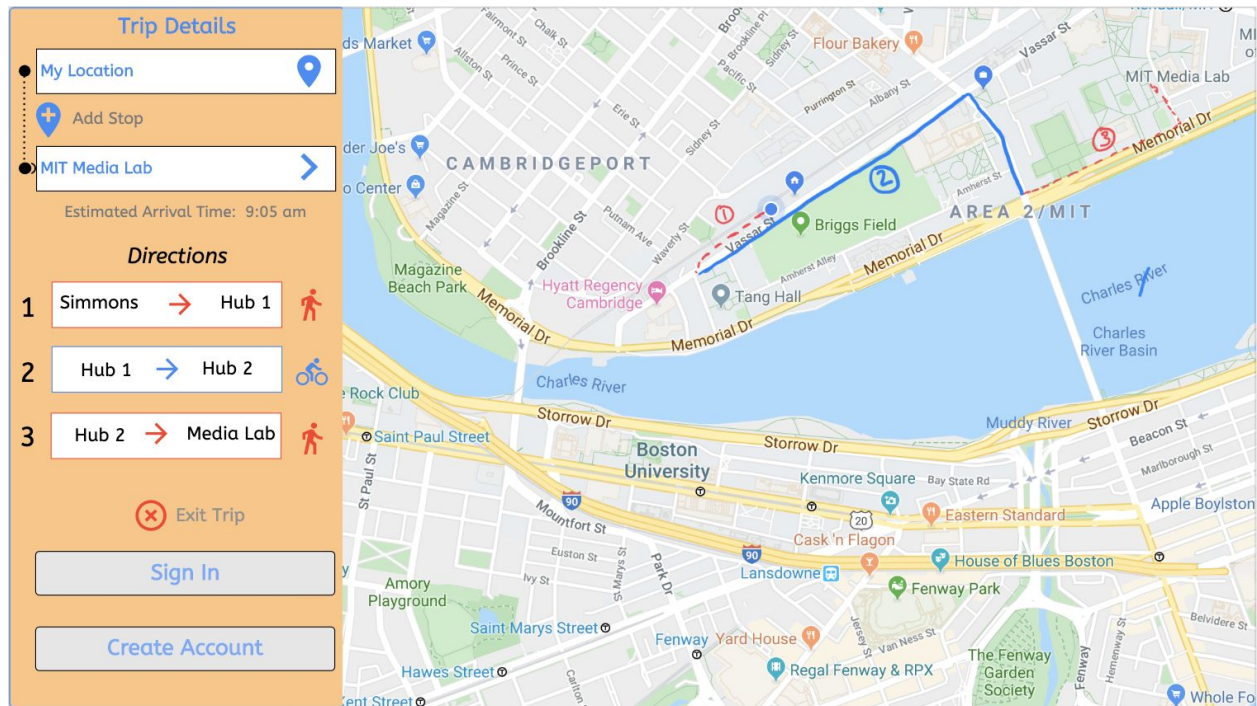
Now, both the map and the left panel have changed to show the details of a Trip from Simmons Hall to the MIT Media Lab. The user can see the estimate arrival time, and they also see specific directions underneath. These directions show the different routes and stops that make up this trip, and they are color coded (such that red means walking and blue means biking) along with the map. In the map, the user also sees the number associated with the routes, such that they match with the directions given on the left panel. The user can also click on the red 'X' next to Exit Trip, which will bring them back to the home landing page. To view more detailed directions, the user can click on a specific route. For example, let's say the user clicks on the first route (form Simmons to Hub 1).
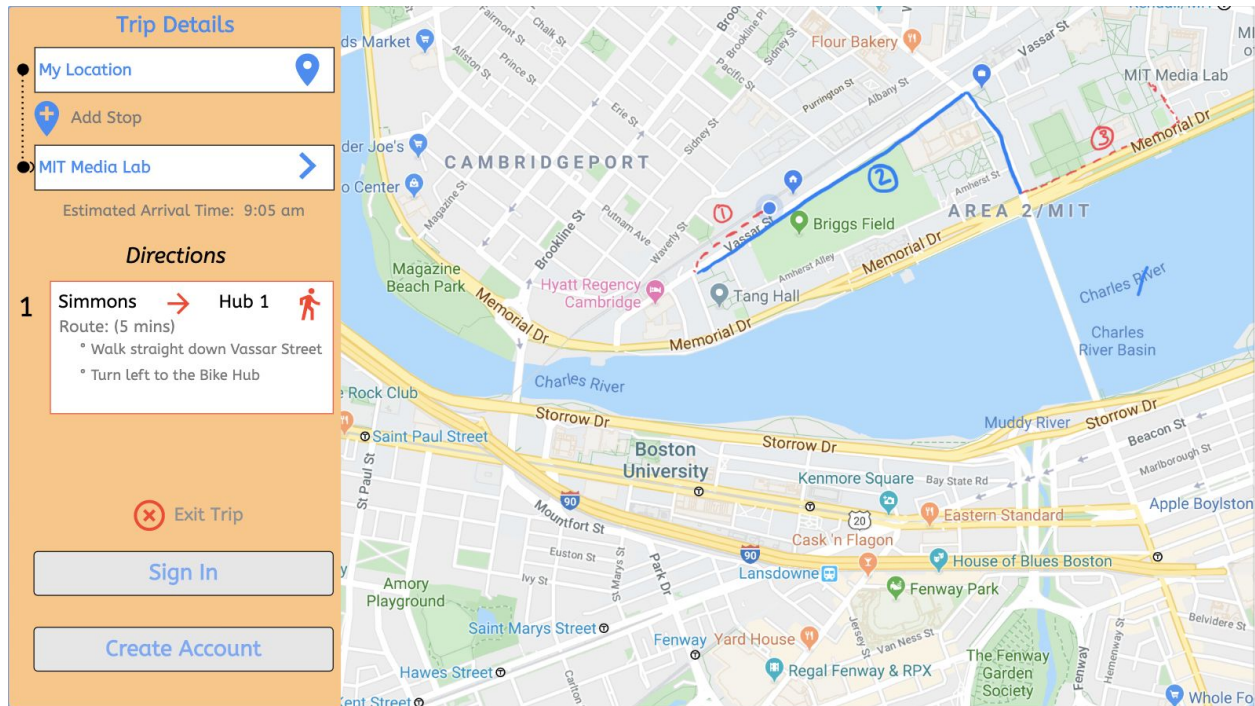
Now, the first Route is expanded. The user sees specific directions, such as when to turn, and also an approximation how long this entire route will take. The user can also expand the second route, which is a biking route from Hub 1 to Hub 2.
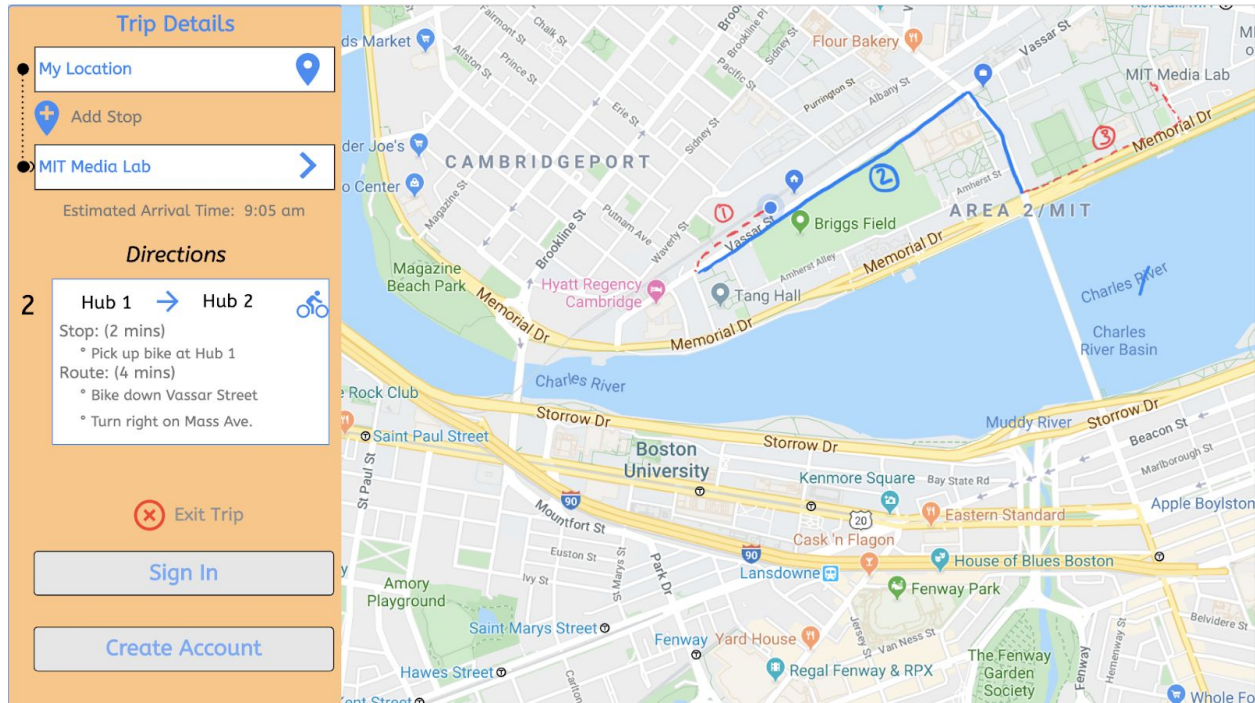
Now, the second route is expanded. Since this is a biking route, the user sees information about the two stops (Hub 1 and Hub 2), such as what they should do at each stop and how long they will need to wait.

This is mostly all of the functionality a user has without an account. To create an account, the user can click on the Create Account button at the bottom of the panel. The page will appear like this, where the user can enter their username and password:

Once this account is created and the user has signed in, they can change their account details any time in the future as long as their new username is still unique, by clicking on an Account button:

Now that the user is signed in, we revisit the page with a trip from Simmons Hall to the MIT Media Lab:
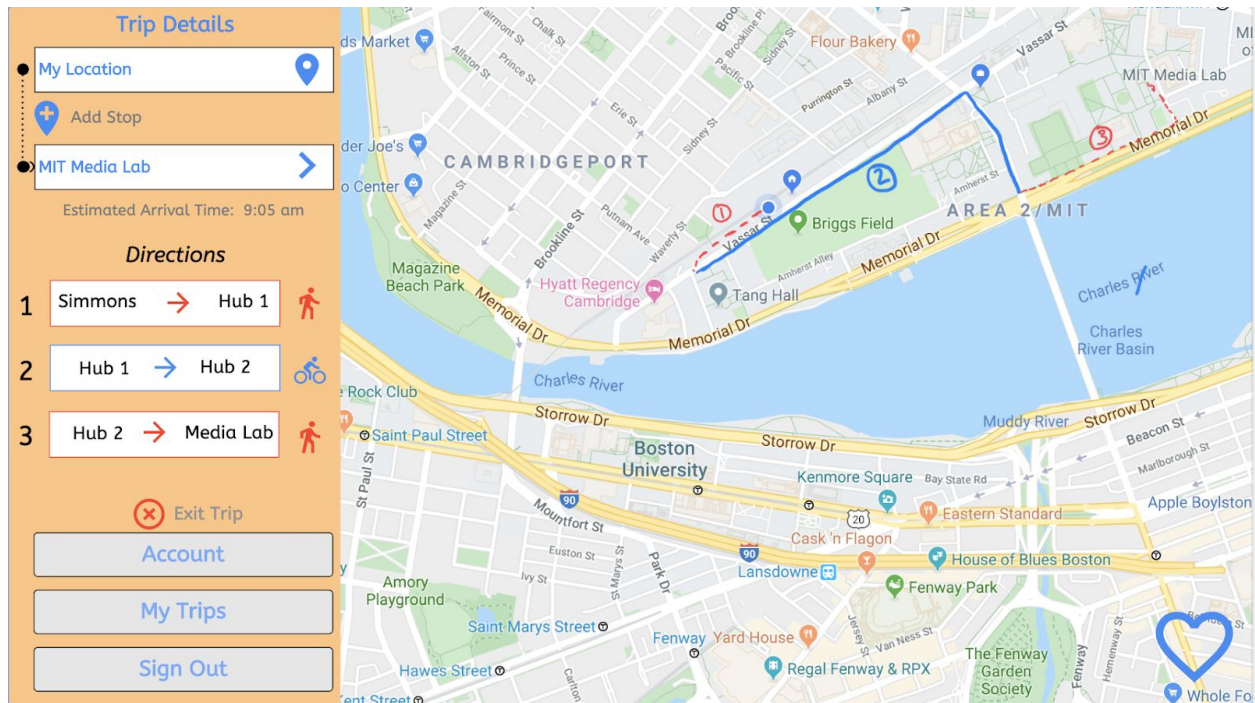
The only difference now is that there is a heart icon on the bottom right of the page. The user can click on this icon to save this trip for future reference:
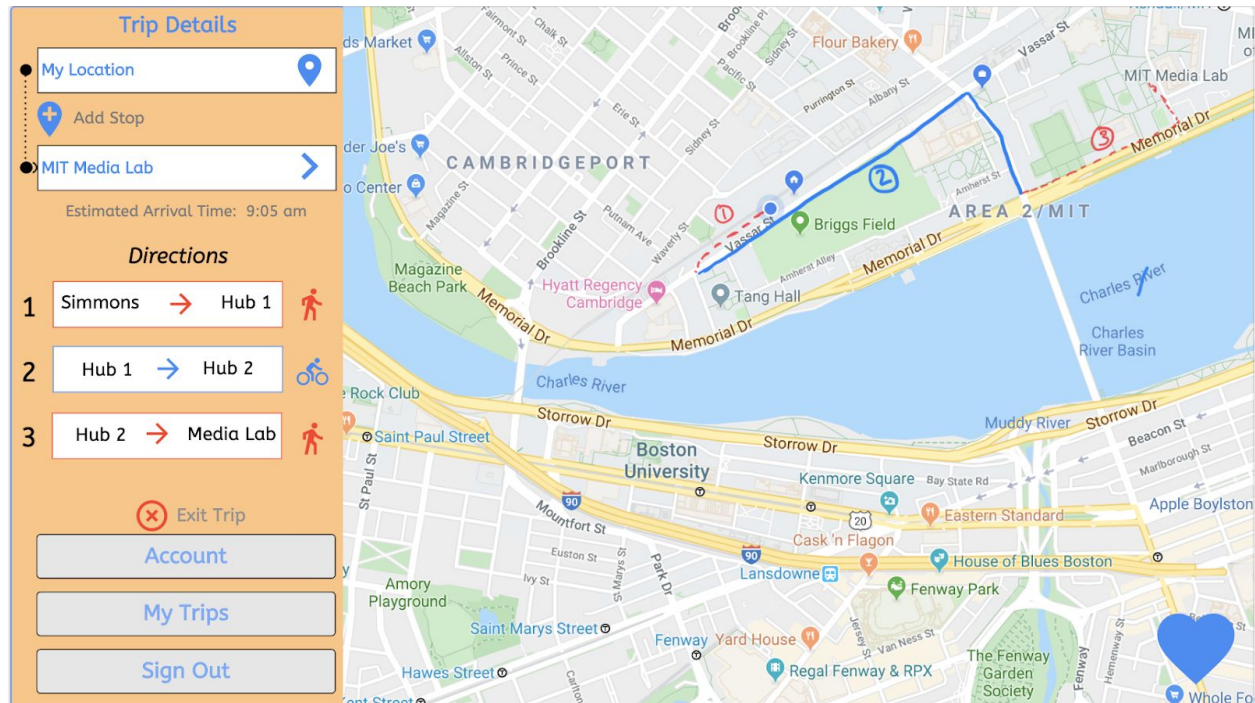
Now, the trip has been saved. The user can look at all of their saved Trips by clicking on the My Trips button on the left panel.
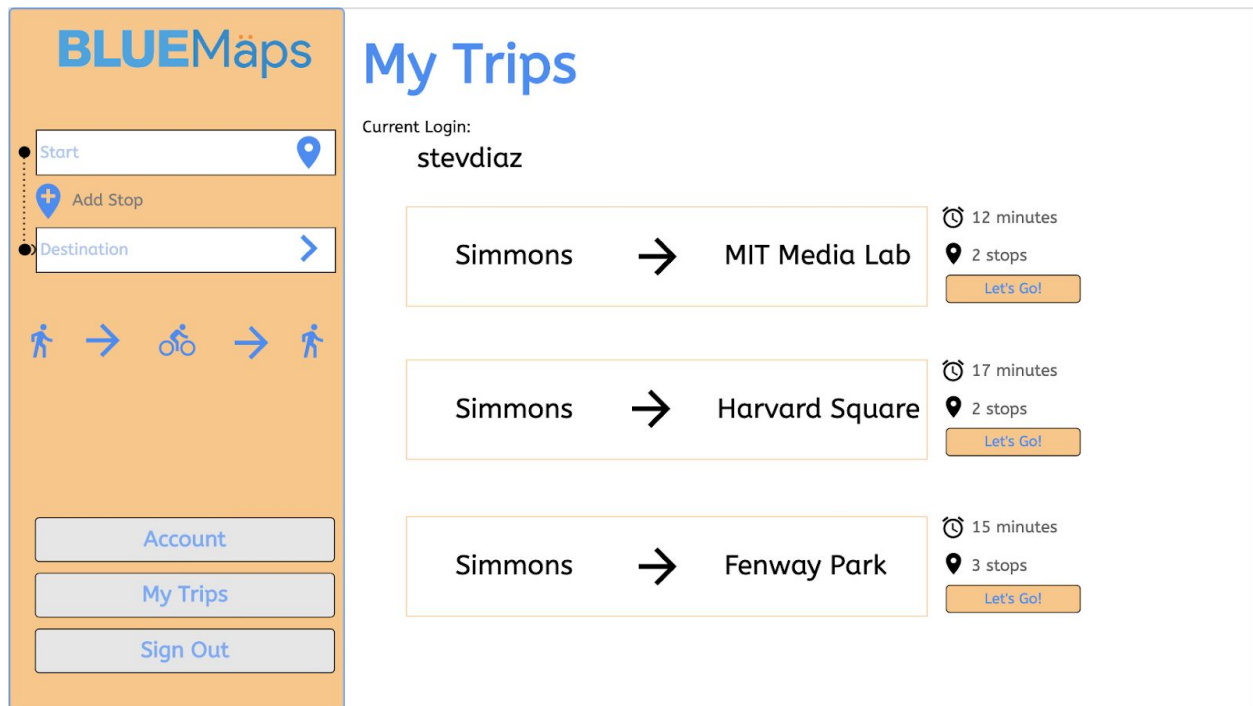
This page shows them all of their saved trips, along with information along the right side, such as the total time of this trip and the number of stops of this trip. The user can also begin the trip by clicking on the Let's Go button, without needing to enter Start and Destination information for this trip. To view more information about a saved trip, the user can click on that trip.
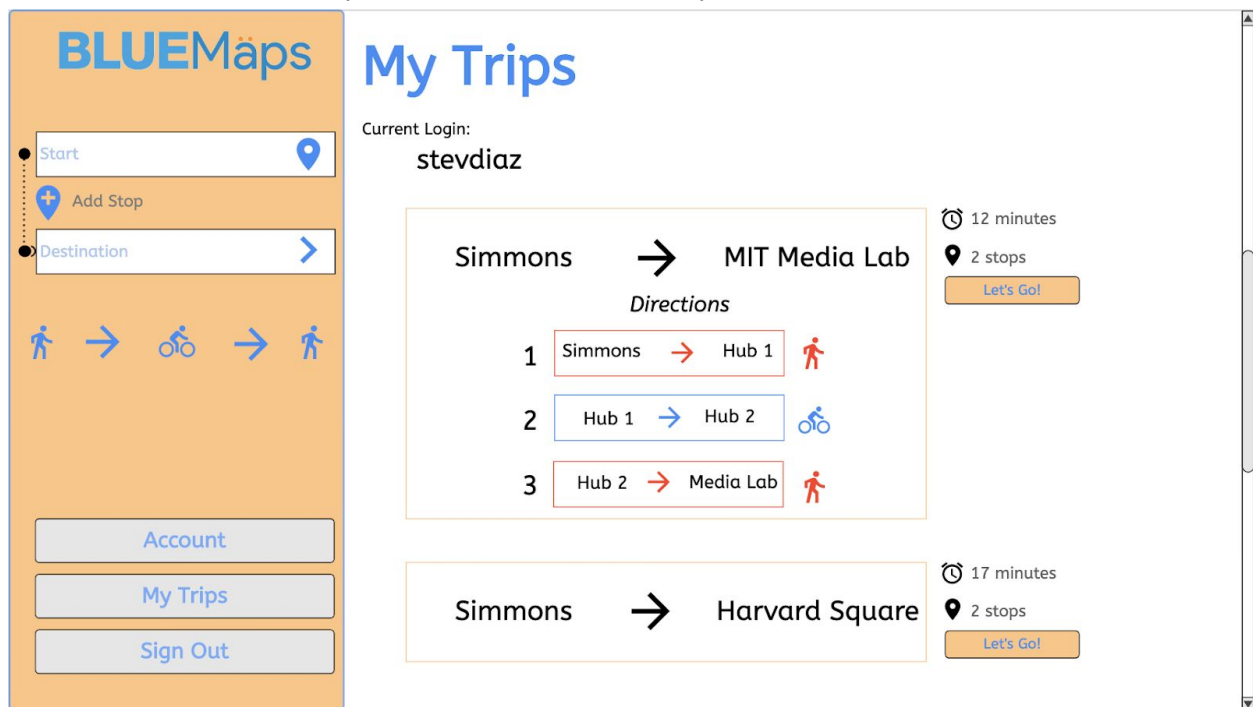
Now, the user sees the specific routes and stops of this trip, and whether each route is a walking or biking route. Additionally, the user can scroll down to continue viewing their other saved trips on this page.

Including the T
One idea that came up as we were designing BlueMaps was whether it should include the T and other public transport options, or not. Ideally, it would be wonderful to include the T, and have it as another type of transportation method in our system. Then, users would be able to have routes which would consist of biking, walking, and taking the T, and this would mean that trips could consist of a combination of these different types of routes. However, realistically, we hit several hurdles as we kept thinking about this version of BlueMaps. Firstly, Google Maps already offers a way to plan trips using public transport options such as the T. In fact, given a start and end location, Google Maps can already plan the route one can take by walking to a T stop, taking the T, and then walking to the destination if needed. Thus, to provide something original and innovative, BlueMaps would have to make trips that are a combination of biking, walking, and taking the T, since Google Maps does not provide this. However, there are difficulties behind this; Blue Bikes are very heavy, and having these type of trips would mean that users would need to carry their bike with them on the T, a difficult task. Additionally, we also thought about the usefulness of these types of trips; most people can get anywhere with the T that they need to, so why would they carry around a Blue Bike as well to begin with? Lastly, we considered the difficulty of this type of solution, and we realized we already have a lot on our plate with the Google and Blue Bike APIs, and so adding another dependency (the API that comes with the T) would be a bit too much. This is why we decided on keeping our system simple for both the user and for the first implementation by having BlueMaps consider just walking and biking routes. This also makes our solution slightly more innovative and helpful for the user.

Optimizing Time or Cost
A design decision that came up was whether we should create trips that optimize for time or for cost. We thought about what each of these means. For optimizing in terms of time, it means we would generate trips that would get users to their locations as fast as possible, by using a combination of walking and biking with Blue Bikes. This means that our app would prioritize a shorter trip even if it meant more money spent. In this case, more money spent means keeping a bike for longer, since Blue Bikes cost $2.50 for every 30 minutes that they are out. On the other hand, optimizing in terms of cost would mean the app would generate trips that save money even though the trip itself has a longer duration. However, we quickly realized optimizing for costs really means having trips that are just walking, since no expenses come with walking. This makes our app just be a weaker version of Google Maps, as it would just always give walking directions to places, never choosing the biking route since it costs money. Thus, we quickly came to the decision that our app would just optimize time, since we can create a much more powerful, innovative app this way that still achieves its main purpose. In terms of saving people money, while trips with Blue Bikes would be costlier than just walking, we believe that they are definitely cheaper than taking an Uber or Lyft across town.

Allowing User-Stops
Another idea that came up was allowing users to add stops to their trips, so they can visit places along the trip before reaching the destination. Previously, the idea of a stop was reserved for bike hubs, as we thought that users would only want to stop to pick up and drop off bikes as they went along their trip. However, we considered the idea of visiting certain places, such as a grocery store or a park, within a trip. This was appealing because it makes sense that users might want to have intermediate stops before reaching the end of their trip. Additionally, with this idea, the app can become stronger and more flexible in terms of travel planning, as users would be able to plan longer trips, and won't need to query the app

again for trips that have different stops. This idea was also appealing because it seems easy to implement once we implement trips between a start and an end. If the user gives multiple stops in between, the app can just create trips between each of the stops, and then combine these trips together to form one large trip. This idea makes sense because users probably want to visit these stops without their Blue Bikes, as they'd have to carry around their Blue Bike, and they'd need to worry about the running expense of the Blue Bike. Fortunately, each trip starts and ends with the user walking, so our idea of generating a large trip consisting of smaller trips between these intermediate stops makes sense not only for us to implement but for the user as well. Because of these benefits we thought about, we decided to allow give users this functionality in our design.

Username and Password
When we discussed having saved trips that users can refer to in the future, we knew that we'd need an account to save these trips under, and when we discussed having an account concept in our app, we knew we'd need a username to associate the account with. We weren't sure whether we needed to have a password or not, as we didn't think we needed accounts to be extremely secure. After all, we thought that with or without an account, users could still use the map and get to their places, so adding a password would not be extremely valuable to our concept. Additionally, our app doesn't provide social interactions, so users wouldn't be able to see the username of others as they interact with the app, which means it wouldn't be easy to log in to someone else's account with just a username. However, we quickly realized that if one user got their hands on another user's username somehow, perhaps by looking at the other user's screen as they interact with the app, then this user would be able to see the other user's favorite trips, and they would have an indication of which places this user visits frequently. This would enable this user to stalk or harass the other user somehow, and we definitely don't want this capability in our app. This can be talked about more in the Social/Ethical reflection, but because of this reason, we decided it would be a good idea to have accounts with usernames *and* passwords, just so that it's harder to hack into someone's account.

Differentiation in Design
Lots of our design decisions in this early phase were motivated by making sure we are different from the other similar products out there, such as Google Maps and the Blue Bikes app. We want to be innovative and original, and we want to provide a solution that can't quite be entirely found in another product. In fact, the original idea of having trips be a combination of biking and walking routes came from the fact that Google Maps only provides trips with either walking or biking between locations, but not both. However, soon after thinking of this idea, we looked at the Blue Bikes app and realized that they basically provided the same solution. Given a start and end location, the Blue Bikes app breaks down this trip by showing the walking portions to and from different bike hubs, and the biking portion in between these bike hubs. However, we noticed that it doesn't have a concept of a Trip like we do, since users can save their favorite bike hubs, but not their favorite trips. So, we decided to build our app around this trip concept, and making sure users understood that trips could be saved for the future. In this way, we believe our product provides a better solution, since it allows users to remember trips which can make travel planning easier.

Stakeholders:
- **Blue Bikes**: They will be used more, and the company will make more money since more people will be using them with our app
- **MBTA**, ride sharing companies: These entities will lose money, since more people will choose to walk and bike with our app
- **Students**: They will be able to plan trips more accurately, such that they don't waste time going to empty/full hubs, so they will be able to save time
- **Tourists**: Tourists that are visiting Boston will be able to easily plan their trips using our planner app to more easily explore the Boston area.
- **Bostonians**: People living in Boston will have easier access to transportation via Blue Bikes and can plan their trips easily with the option to save their favorite trips so they can revisit it in the future within re-entering location information.
- **Public roads (bike lanes):** With increased use of Blue Bikes, public bike lanes will be stress-tested and if the capacity is not enough, then bike banes in Boston may have to be expanded to accommodate the increased use of bikes.

Issues and Social Analysis:

Our app provides functionality for users to plan trips and therefore make it easier for users to exercise and save money. One of our goals is to provide fitness statistics for users, including the miles traveled via walking / biking over a time period, in order to provide incentives for users to use our app and exercise through walking or biking. Additionally, since MBTA costs $1080/year ($90/month) and Blue Bikes costs $99/year for their subscriptions, subscribing to Blue Bikes is vastly cheaper than riding the subway everyday. This means that ultimately, by providing an incentive to use Blue Bikes through our app, we are saving users' money.

By promoting biking and walking over driving, our app will help reduce carbon emissions from cars, which are harmful to our planet. Nowadays, in order to travel from one place to another, people may opt to ride Uber or Lyft, which is harmful to our environment because Uber and Lyft drivers drive cars that are (for the most part) not eco-friendly. On the other hand, walking and biking are better alternatives that do not produce any carbon emissions and will not affect the environment negatively. Therefore, as more users choose to use our app and Blue Bikes over Lyft/Uber, there will be less carbon emissions for the environment and less contribution to global warming from cars driven in Boston.

Our app allows users with an account to save their favorite trips for future reference. This means that the app will hold private user data concerning the places that users like to visit, and where the users mostly spend their time. While this design decision makes it more convenient for users to frequently plan the same trip, it comes with a huge responsibility, since this data might be extremely valuable to certain companies. In fact, this data can be stolen, and used in ways that are malicious for the user, such as for tracking them or for providing ads that are relevant to the places they are visiting. To keep our users' trust, we will take on this responsibility by making sure the data is safe and secure.