Mobile Application for Hikers
Final Report for CS 2699 – Undergraduate Research, Spring 2022

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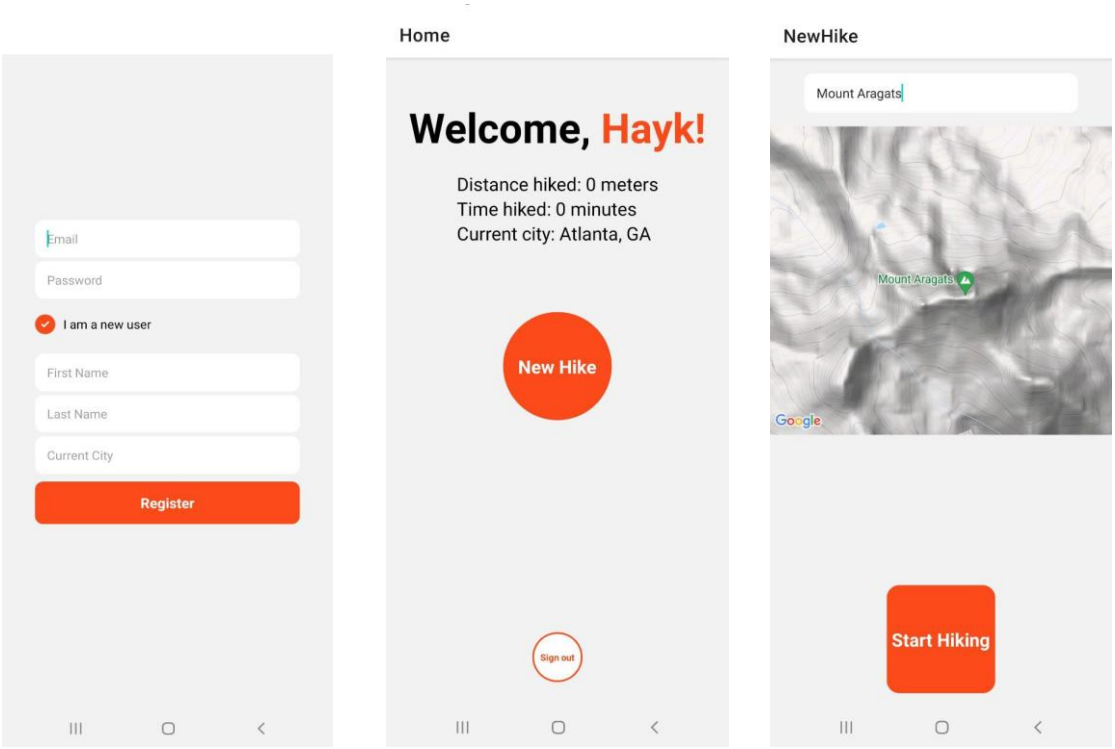
Problem Addressed and Relevance

This semester we developed an end-to-end mobile application for hiking. Many hikers often seek recommendations, especially those outside the US where hiking trails do not have directions along the way, on which way to take, or how to tackle some parts of the mountain. By creating this application, we give them a social engagement and community-building opportunity, allowing them to post audios right from the hiking trails. Later, when new users visit the same spots, we provide them with previously recorded audios which can include very important and helpful information (e.g., taking west from here opens a gorgeous view to the highland or do not go north to avoid slippery land). Furthermore, we use GPS to show users their trajectories on the map as well as provide statistics such as current altitude and heading, which can be helpful for the hike.



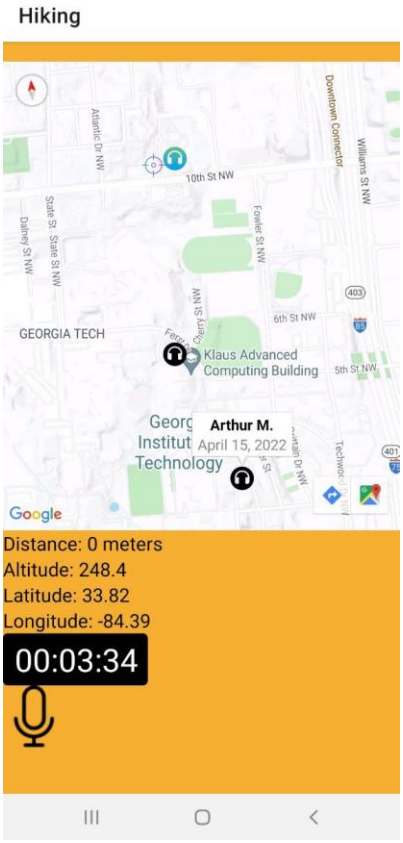
Related Work

Similar applications have been developed and are currently widely used for general fitness purposes such as running and walking. Apple Fitness, for example, can be integrated with Apple Watch and by using the sensors available in the watch, Apple is able to track users' statistics (distance traveled outdoor, number of gym exercises completed, etc.) throughout the day and fitness activities. All Trails is a travel application used in outdoor recreational activities. While they have some similar features such as a hiking trajectory map and tracking, they do not have the social engagement feature that we developed.

Approach and Results

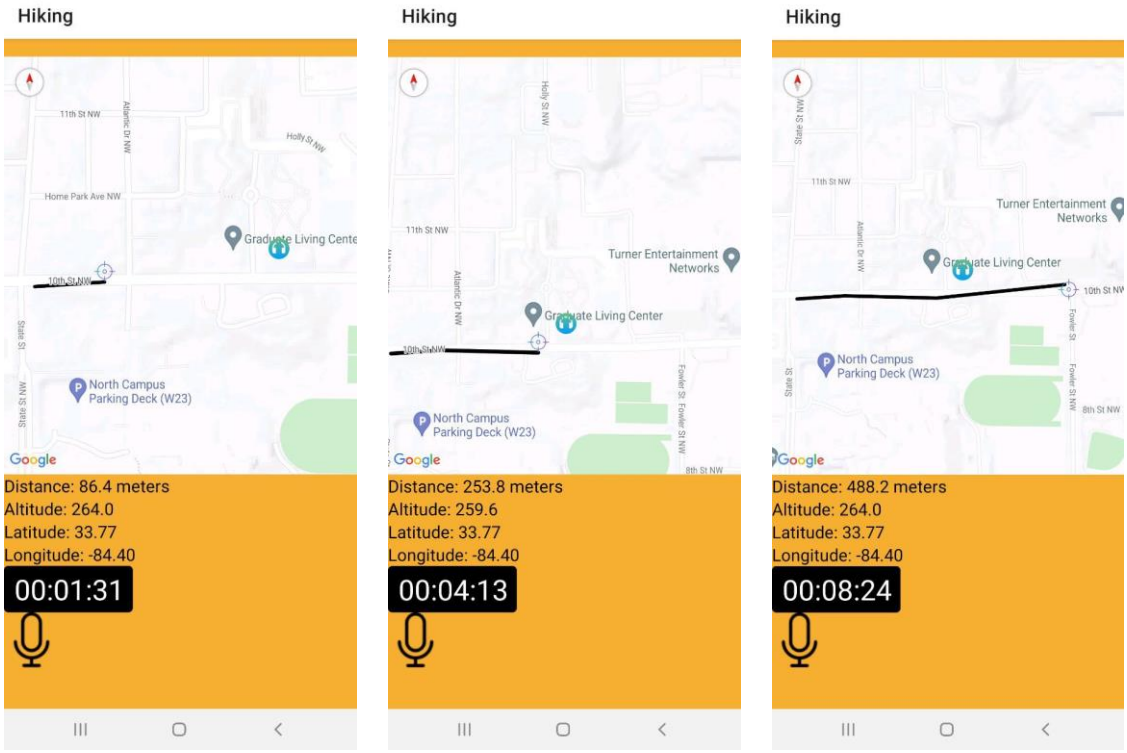
We started the development of the application by first conducting interviews with potential users of the application. After finalizing the main features of the *minimum lovable product* version of the application, I developed a UI interface using Figma and started developing the app using React Native.

Our application allows users to record audio messages anytime during the hike. Moreover, every time users are within 200 meters of a previously recorded audio, they can see the audio information on the map and play.

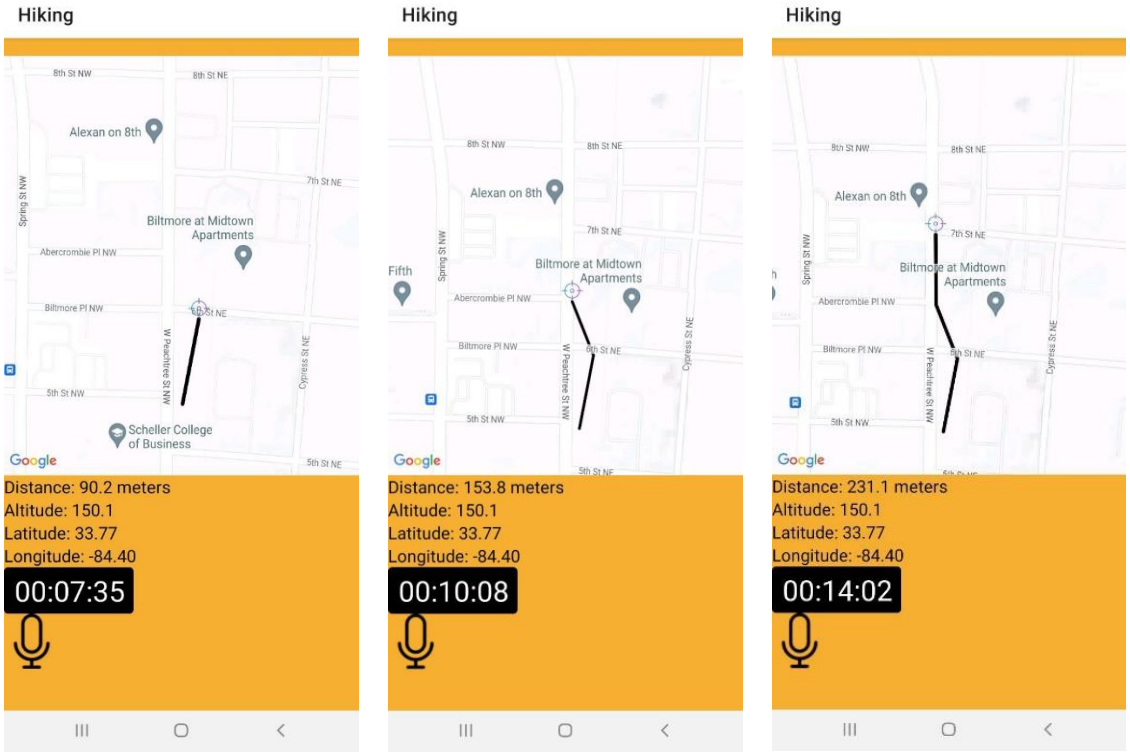


I also implemented an algorithm to calculate the distance traveled by the user while they hike. Every time the geocoordinates (latitude and longitude) changed, I used the haversine formula to find the small displacement and add it to the total sum. This algorithm has been tested in two different scenarios.

The first experiment was on 10th Street, which does not have any high buildings, and the results were good as expected, differing from the ground truth value of approximately 6 meters.

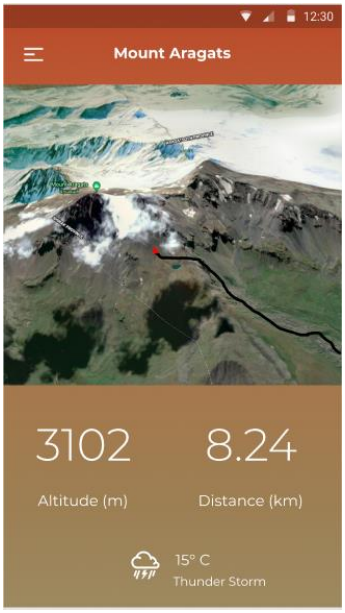


I later tested the algorithm on Peachtree Street, where the buildings do not allow the connection between GPS sensors and satellites to be stable, leading to a worse result ~20 meters of difference from the real value.



Future Work

There are many developments for this application that we discussed but did not include in the first version. I will also be sharing our app with beta testers whose feedback can be used to add new features and make improvements to the current version. One new feature can be a 3D map (e.g., Google Earth) that will allow users to see how far they are from the top of the mountain, as well as explore the surroundings to avoid potential difficulties (UI design below).



Also, as we already discussed above GPS is not the best tracker when it is difficult to reach the satellites. Therefore, we can try using the phone motion sensors, especially the step counter, to potentially improve our tracking features.

Meta: learning

This was my first experience when I went through all stages of software development, starting from interviews with potential users and user interface design and ending with pushing the app into production.

I have learned that it is important to design a *simple, stupid* most lovable product version for the application. When we first started discussing the project, I was thinking of complicated features. Although the features could have been helpful, those were unnecessary for this version and could have delayed the first release and testing of our app.

I have also learned that it is unnecessary to build things that have been already implemented for us. For example, I was trying to create a database feature that would work offline and push everything to online servers when internet became available. However, this would have been too much work and no development in the application itself. This is why finding and using Firebase was important to make the development faster.

I learned a lot about how main motion sensors, GPS and IMU work, which will be useful for my future robotics projects. This project also allowed me to gain new technical skills: React Native, Figma, and Firebase.