Stop the Spread
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Abstract
Imagine getting infected with COVID-19 and not even knowing it. That's the reality that many of us have lived with. In order for us to keep each other safe from COVID-19 we need a way to contact trace, find out who a person with COVID-19 may have spread the disease to, and we need to do it in a way that's scalable. That's where our app Stop the Spread comes in.

This app is cross-platform, which means it will work on both Android and iOS mobile operating systems. To start, the user is able to create an account and can choose to share their location. There are several pages the user can access once registered. One of which is Settings, where the user can report their infection status (Negative, Symptomatic, Positive). Once the user shares their location the app will track where they have been and if they report positive, the app will go through their location history and inform other users that were in close contact with the infected user. Another page is Map, which will display a heatmap of other registered users along with a specific color that represents their infection status (green = negative, yellow = symptomatic, red = positive). This allows users and contact tracers to identify the density of different infection statuses and their location or avoid going near locations with such densities. The next page is Contacts, which will display a possible contacts list that describes whether they were in close contact with other registered users that reported positive. This allows the user to quickly get tested and quarantine, and contact tracers can quickly identify and locate the positive contacts. The last page is Resources, where users can quickly access the CDC website that contains valuable information about nearby cases, COVID-19 statistics, vaccine information, and more.

Our project will be a boon to public health by providing a scalable method of contact tracing by tracking its users location data and self reported infection statuses and showing users where high risk areas might be so they can avoid those areas.

Introduction
One of the worst aspects of the COVID-19 pandemic is how easily the disease spreads. COVID-19 is extremely infectious with the ability to spread through respiratory particles and anyone infected with COVID-19 could start spreading it before they show symptoms. This makes contact tracing difficult as the number of people an infectious person comes into contact with grows exponentially with each day before the infectious person finds out they were infected. To help the contact tracing effort, we were tasked with designing an app that would automate contact tracing.

Implementation/Design
For this project we chose to implement it with a couple different types of technologies. If we were to break down the project, it was done in three parts. The mobile app, the server and the database.

First we can start with the mobile app. For the mobile app we decided to use React Native. We decided on React Native because it's a modern multi platform framework that allows us to develop the app for Android and iOS at the same time; this saved us plenty of time when developing the app since we didn't have to write different code for different operating systems. Another great thing about React Native is that even though it's a new and modern framework, there are plenty of public libraries to help us manage and style different aspects of the app.

For the server we decided to go simple and went with Python. We decided to go with Python because it's simple and easy to use; especially when dealing with databases. The server was in charge of the contact

tracing algorithm and was hosted on Heroku. We picked Heroku since we find this hosting service to be streamlined and user friendly, even for people without much development practice.

Finally, we went with Firebase as our database. This was a pretty easy decision since Firebase offers many tools for developers, database managers and is very user friendly. When we first started the project we were planning on having an admin web application but that was quickly made obsolete when we could easily access and manage all the data from Firebase. Firebase also made it easy to integrate users into our ecosystem with user authentication built into our realtime database.

Contact Tracing

Our contact tracing algorithm was developed separately from the mobile application. This was done for flexibility and to make it easier to develop it further in the future. The contact tracing algorithm follows a simple process. Once a user reports that they had a positive covid test the database pings the server to check the locations in our database for the positive user against all other users that may have come in contact with that user.

To save time and resources we store the counties associated with the gps coordinates sent to the database. This is so we don't waste any time checking to see if a user in California may have come in contact with a user located in Colorado. After we determine what dataset we are going to test against the positive user, the contact tracing algorithm is ready to run! First we grab the timestamp associated with the two locations that we are testing. Then the algorithm checks if they are both within 10 minutes of each other and if they are then the algorithm continues and checks to see if those two locations were within 6 feet. If they both come back true, we have a positive contact! The server then pings back to the database inserting a new positive contact for the user involved! Once it's in the database the user that has that positive contact will see it appear in their contacts tab in the app. If the distance or time period is greater than the parameters the possible contact turns into a negative contact and is not stored anywhere.

Results/Analysis

We were able to complete the software specifications and requirements for our client, which are: user authentication with infection status and location tracking, contact trace by using infection status and location, and provide COVID-19 resources. The user authentication was developed through Firebase with working sign-up and sign-in screens. Location tracking and infection status works by utilizing the GPS sensor on the phone, reading the user's infection status input, storing this data in the Firebase RealTime Database, then displaying this data on Google Maps in the form of a heatmap. The contact trace works by applying our algorithm on the user's infection status, location coordinates, and time. This will display a list of all the positive contacts for the user. COVID-19 resources work by providing an embedded view of the CDC website, which contains useful information such as COVID-19 vaccine, statistics, work/school, and many others.

There were many challenges during the development process. These include but are not limited to learning a cross-platform framework(React Native), debugging specific platform issues, outdated libraries, screen size dynamicity, database and server issues. Through perseverance and curiosity, these challenges were no longer relevant. The end-product is one that not only meets our client's specifications and requirements but is impactful worldwide.