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Report 1

I/ Introduction

1. Background

My senior project, named Raether Map, is an Android application that allows users to locate library materials, particularly books, DVDs, and study rooms. I work part-time at the Trinity Library's Circulation desk. When working here, I notice that many students, especially freshmen during the first few weeks of school, have difficulty finding books or rooms in the library. They can go to the circulation desk for help or use the paper map. However, this process is inconvenient because the paper map can be hard for students to comprehend and might not contain temporary or updated information such as the location of an event held in the library or change in location of a classroom in the library. The library has tried creating an updated map of the library with more comprehensible location's names, but that means some other old information was deleted to make space for the new visual effects. It is also inefficient to have many students coming to the circulation desk asking the same question about a book or the location of a room. With a mobile indoor map, students can have a more personal and interactive book searching experience in the library.

2. Goals and Objectives

- Complete a map of the library on Android that generally allows user to search for the shortest possible path to the library material the user is looking for (by the shelf).
- Learn Android programming to develop a complete Android application, this includes:
  - Front-end (client-side): Understand the principles of designing clean, nice, and user-friendly user interfaces for the application.
  - Back-end (server-side): Retrieve and study the database of all library materials. Find a way to build the application's separate database to maximize the performance of the application. Keep the application updated according to the current state of the library.
- Understand the criteria for indoor mapping and find the most suitable tool to create the indoor map on Android.

3. Significance

Currently the library only has a website for the catalog and paper maps of the building. Therefore, students and faculty would need help locating the library resources they are looking for. Raether Map is a combination of library catalog and indoor mapping. With this application, users can conveniently search for and locate library resources. In addition, the app will save library staff from tons of repeating questions about books' or rooms' location, at the same time providing users with a more private and personal experience in the library. There are existing applications for mapping library on demand, such as the Google Indoor Mapping project or StackMap. Raether Library is currently well mapped on Google Map. However, this only allows us to see where things are, but does not provide a direct search for book's location or broader search of library materials (search through topics or author). On the other hand, StackMap does provide both catalog and mapping features. However, the school would need to pay for this

service. Moreover, since StackMap is a mapping tool for many libraries in the US, it is unlikely to offer customized features for Trinity Library. Having worked at the library for two years, I understand the wants and needs of the library staff as well as the students and faculty who go to the library, thus will be able to pay attention to the details that serve Trinity Library well.

II/ Implementation:

1. Overall structure of the software project

- Front-end: The project is an Android application. The interface includes a map that uses collapsible search bar on the top menu. The map images are the current static maps of all floor plans in the library. The blue dot and marker that shows user's current location and location of the item respectively are using the positioning system of Indoor Atlas.
- Back-end: I am using Firebase to manage a real-time database for my application. I drew data from Alma, the library database management system Trinity is currently using, and converted it to a JSON file compatible to Firebase. On the other hand, the location information is stored in the cloud database of Indoor Atlas.

2. Current progress

- Met with a librarian and set up the URL that gives access to all materials in the library. Studied Alma, retrieved the data from the URL and converted it from xml to a json file compatible with Firebase. Uploaded the database to Firebase
- Uploaded the current static library map as floor plan background for the map. Aligned the map to the correct position on the world map on Indoor Atlas website.
- Used the MapCreator2 application on Android to complete the map generation process on Indoor Atlas using the Pedestrian Dead Reckoning technique.
- Used the sample code of IndoorAtlas as a resource to show the map on the application: the map of the library is shown with a blue dot as the user's current location.
- Added a collapsible search bar in the menu that uses the query to search a book by title and returns all call numbers match that title.

3. Challenges

- Decide which database to go with. After I chose Firebase as the real-time database for my application, it took me some time to get used to Firebase.
- Retrieve all data from the database to a JSON file for the application. The database contains around 900,000 books, but each API query can only call at most 1,000 books. Thus, sometimes creating these calls can cause errors (too many requests).
- It was difficult to manually align the map image on the Indoor Atlas perfectly. To overcome possible positioning errors, I did thorough recording on the MapCreator2 application and would perform many tests for the positioning.
- The application can be inconsistent due to dependence on the external libraries of Indoor Atlas, so I'll need to come up with a way to handle the crash cause by this inconsistency. One possible solution is to switch to Google Map if a crash of map interface occurs.

III/ Preliminary Results and Expected Outcomes

Functionality working component:

- The application main interface is the map of the library (particularly the floor that the user is on) with a blue dot showing the user's current location. The interface has a collapsible search bar on the menu, where users can open by tapping on the search icon.
- User enters information of a book (call number, name, major) or a room in the building. If the query is valid, the result will be the approximate location of the bookshelf holding the book (if the book is available) or the exact location of the room, shown through a marker on the map.
- The user should feel comfortable zooming in and out and rotating the map to have a better sense of direction.
- Collapsible search bar in the menu that uses the query to search a book by title and returns all call numbers match that title.

Additional modules to implement:

- The map will show the shortest possible path from the user's current location to the result destination. This minimum path calculation should account for floor differences.
- As the user walks, his/ her location will be updated, but the path will not be updated until the user hits refresh.
- Search bar should allow for reasonably flexible input.
- User can search by topic, author, year, or course requirements. The search will give a list of related books. Then the user can click on each item to see where the book is.
- The database should be kept updated to current database of the library.

IV/ Conclusion and Future Work

- **December**: Show the result as marker on the map
- **January**: Add location information of the library materials to the dataset
- **February**:
    - Create path instruction from current location to destination
    - Allows more flexible input search
- **March**: Study efficient way to keep the database updated to current state of the library.
- **April:** Gap time for unexpected problems/ delays.