

Reference Map App – CBU Mobile

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Abstract—Technology today allows individuals to have access to services and reference documents such as maps and contact directories at their fingertips. CBU Mobile offers an alternative to paper and .pdf maps that are currently provided by Christian Brothers University (CBU). It provides students and guests with a user-friendly mobile application available on both iOS and Android to provide an interactive map and a reference guide of all the faculty at CBU. CBU Mobile uses Firebase Cloud Firestore database, which fully supports offline functionality and uses asynchronous communication to transfer data, which allows for information to be updated in real-time. The database stores information about campus buildings, along with faculty contact information and office schedule.

Keywords – app development, database, map, cloud

I. INTRODUCTION

CBU Mobile is a platform that allows students, faculty, and guests of the campus to locate valuable resources across the campus. It is supported on both iOS and Android devices, which makes it available to a wide range of users. Paper maps or PDF maps are often given to new students and guests that arrive on campus to help navigate themselves around campus; CBU Mobile provides a modern alternative.

The app will have two main functions: Digital Map and Search. The Digital Map will allow the user to see a detailed map of the campus and track their current location (this feature is disabled if they are using the app off-campus) and will be the point-of-reference for building locations when a user drops a pin. The search tab is where all the logic takes place. It will display the list of buildings and faculty available on the campus and allow the user to select one. From the building search, once a selection is made, the map tab will reopen, and a pin will be placed on the map. The user can then tap this pin and show information about the building. From the faculty search, once selected, a new view will appear showing the information about that faculty member.

Although paper maps and PDFs meet the current needs, the alternative of a digitally designed map overlay is more versatile. Any change made to the map requires a new print of the map to be developed. This renders the previous printed maps outdated, which in turn, wastes paper. Additionally, it would be hard to ensure that students and guests have an updated map. PDFs can also have this update issue.

Additionally, PDF maps can sometimes take a long time to load or be hard to read on a small screen without zooming in and scrolling. CBU Mobile addresses these issues by adding an overlay on top of Google Maps. Using this style of map, users can search and locate any building on campus as well as know their location on campus using live location tracking. If the user steps out of the campus, data tracking is turned off until they return to campus. App features are still available off campus. Additionally, CBU Mobile offers students the ability to access information such as faculty office hours, email, and office number.

The data of the buildings and faculty members are stored on a database service called Firebase. CBU Mobile specifically uses the Firebase Cloud Firestore database service, which allows data to be fetched asynchronously and offers better scalability than the traditional Firebase Real-Time Database. This means that with more users, Firebase can determine where more resources are needed and make sure that downloading data does not slow down as more users open the app. This proves to be a fast, reliable method for downloading faculty, building, and map information. For building photos, however, that data is stored in a Cloud Storage bucket, which allows us to download photos in real-time. Additionally, this requires a “real-time” downloader, such as PINRemoteImage (Pinterest’s Free-of-use photo downloader) that can download bits of the photo very fast. Note: this requires photos to be compressed to the lowest quality, so the app can convert to high quality, providing a fast download. Effectively combining these services makes an amazing, fast app in which processes all work together and asynchronously.

II. FIREBASE CLOUD PLATFORM

Firebase is a complete mobile development platform, which gives the developer many tools for creating a complete backend for both mobile and web. Firebase includes many features that make creating a complete platform easier for the developer.

A. Cloud Firestore

Firebase Cloud Firestore is an asynchronous NoSQL database, which is built for usage across web and mobile [1]. Cloud Firestore supports offline usage with local device caching, making CBU Mobile fully functional without an internet connection.

B. Cloud Storage

Firebase Cloud Storage is built for the Firebase Cloud Platform and allows easy file upload and download, which is aimed towards storing videos, photos, and files [2]. CBU Mobile uses Cloud Storage for storing campus photos.

C. Cloud Hosting

Firebase Cloud Hosting provides fast and secure web hosting and allows for simple deployment of single-page web applications [1].

D. Firebase Authentication

Firebase Authentication provides secure, flexible authentication; with various sign-in methods such as email, Google, Facebook, and Twitter [3]. CBU Mobile uses email-and-password-based authentication, which allows the user to have a separate account from Google, Facebook, and Twitter account.

III. FIREBASE INTEGRATION

CBU Mobile integrates features of the Firebase Cloud Platform such as Cloud Firestore, Storage, Hosting, and Authentication to make updating and presenting information work seamlessly in the background for the user's experience. With all the data in Firebase, the app can quickly and efficiently pull that information to the user, along with caching on their device for offline use. This way, even without a data connection, they can continue to get detailed location data.

Firebase Cloud Firestore is used for storing the campus building information and faculty information. Firebase segments data into hierarchical data structures: building data is stored in "documents", shown in **Figure 1** on the left column, and these documents are stored within "collections." [1] Each document is assigned a unique identifier and contains an Object for each building, populated with the data for that specific building. The building Object contains the data for the building: coordinates, description, photos, title, type, and description shown in **Figure 1**.

Faculty information is stored in a separate collection from buildings, and each faculty document has been assigned a unique identifier containing an Object with data for each faculty

member. Shown in **Figure 2**, each faculty Object contains data for the faculty: building, department, office number, name, phone number, website, and email. The building attribute is linked to the unique identifier associated with each building. This is used to link faculty members with the specific building document of their office location.

Faculty office hours information is stored in its own collection, and each Office Hours document holds an Object for the faculty-specific office hours. Each object contains a reference to the specific faculty document and separate arrays containing hours for each day which is shown in **Figure 3**.

IV. USER INTERFACE

Upon opening the app, the user is presented with an interactive map of the campus as well as their location (if they are inside the campus) [4] [5]. The map of campus includes a colorful map overlay, making it easy for students to differentiate the type of building based on color. The map is designed this way to help students and guests, over time, better identify which buildings are resident housing, school, dining, or student resources. Both iOS and Android apps were designed to get the information the user is looking for with the least number of clicks on the screen as possible.

On iOS, the users are presented with tabs at the bottom that follows iOS' (Apple's mobile operating) custom tab-based view controller for tab-based apps. Additionally, this allows the information to be sectioned off separately to avoid confusion between the different tabs. The map tab is the main tab, and the other two tabs are used for searching **Figure 8**. The search tabs are for searching for certain buildings or looking up faculty information **Figure 9**. The list of the buildings and faculty are cached from the database upon first boot of the app if connected to the internet.

On the Android version of the application, users are able to search for buildings using the search bar at the top of the interactive map shown in **Figure 4**, and quickly and easily switch between the interactive map and faculty directory by sliding from the left side of the screen. This opens a menu shown in **Figure 5** that allows them to swap between the interactive map and faculty directory. On the faculty directory, users are able to filter through the list of faculty members by department and name using the search bar at the top of the screen shown in **Figure 6** [6]. When the user selects a faculty member from the list, they are taken to the faculty description page shown in **Figure 7**.

V. CONCLUSION

CBU Mobile revolutionizes the way that users will be able to locate faculty, buildings, and points of interest. It makes finding buildings, faculty, and faculty information easier than ever before. Instead of having to navigate through web pages dedicated to each department, the user can easily search for the name they need. Using Firebase Cloud Firestore, this

makes downloading and caching object data a breeze. Requiring custom authentication within Firebase, so that faculty can edit their own information, also makes the app more secure and less prone to malicious intent since users are only granted rights to edit their own information. Using Firebase Cloud Storage, CBU Mobile effectively and easily grabs building photos and downloads them to the app in real-time. Having a simple, familiar User Interface allows the user to spend more time using the app and less time trying to figure it out. This effectively increases productivity and guarantees that users are both familiar and comfortable with CBU Mobile.

With data cached automatically, the user can rest-assured that the data is available even when they might not have connectivity. Overall, this makes using the app a great, simple, and familiar experience.

REFERENCES

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<https://developers.google.com/maps/documentation/ios-sdk/intro>
- [6] "Android Studio RecyclerView Documentation"
<https://developer.android.com/guide/topics/ui/layout/recyclerview>

FIGURES

Fig. 1 Building Database

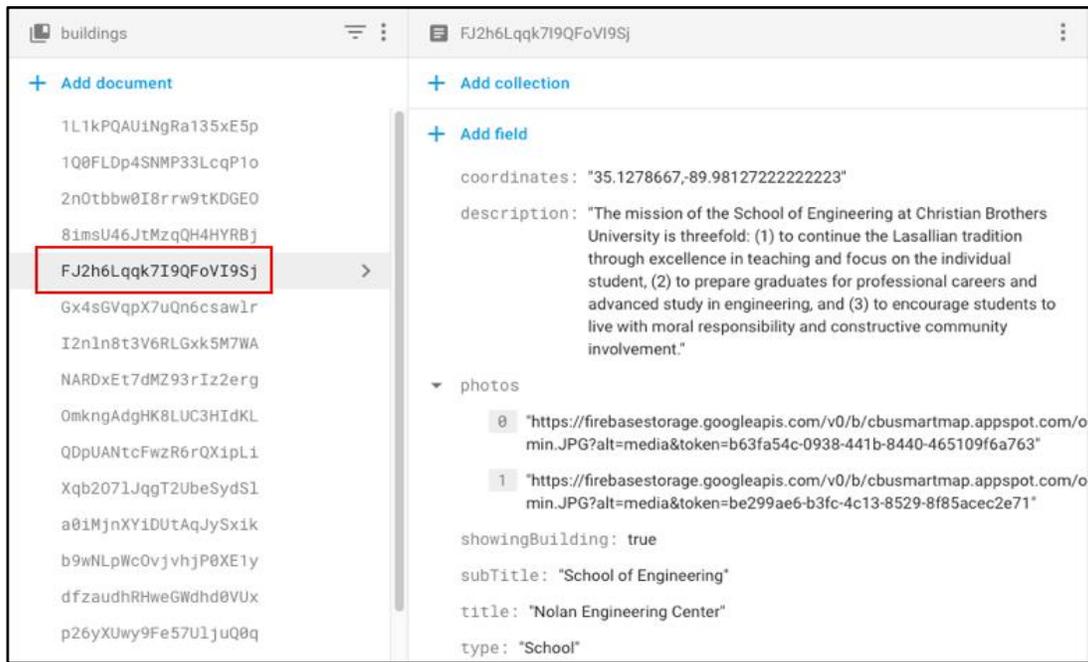


Fig. 2 Faculty Database

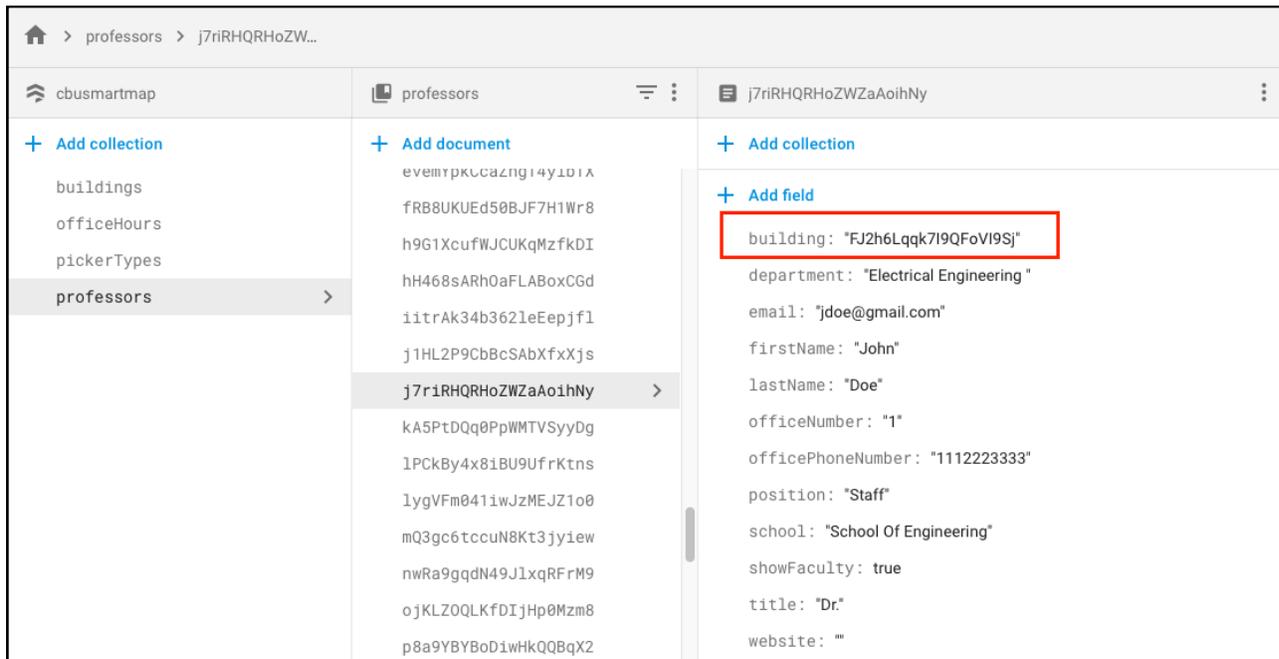


Fig. 3 Office Hours Database

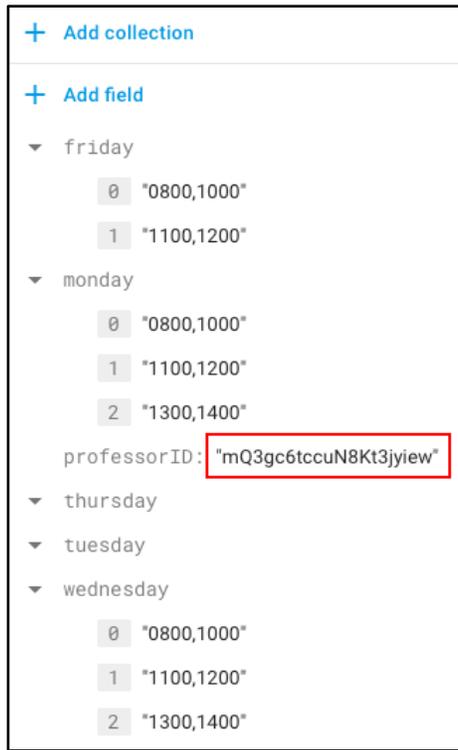


Fig. 4 Building Search

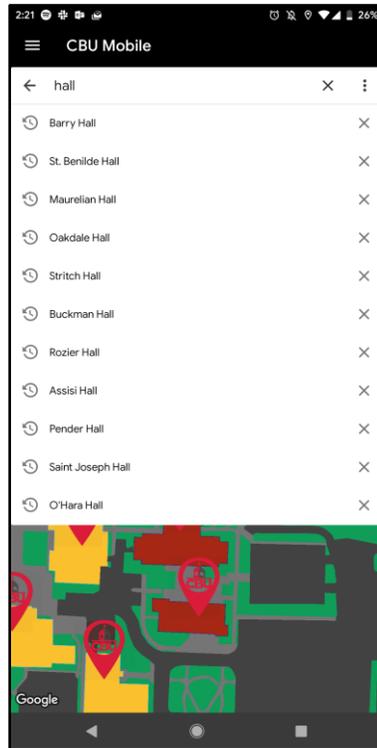


Fig. 5 Menu

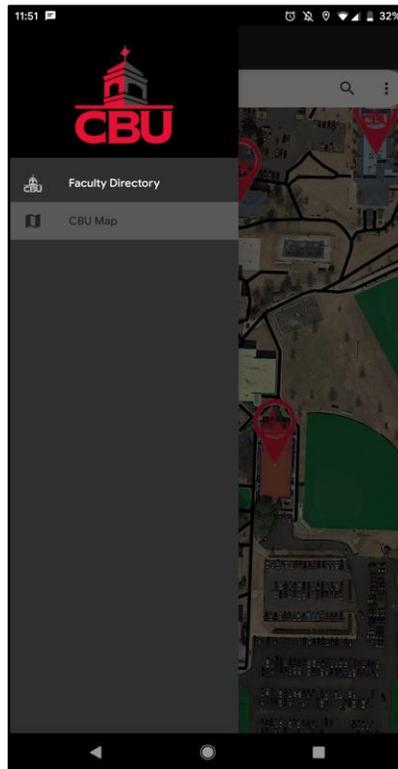


Fig. 6 Faculty Search Android

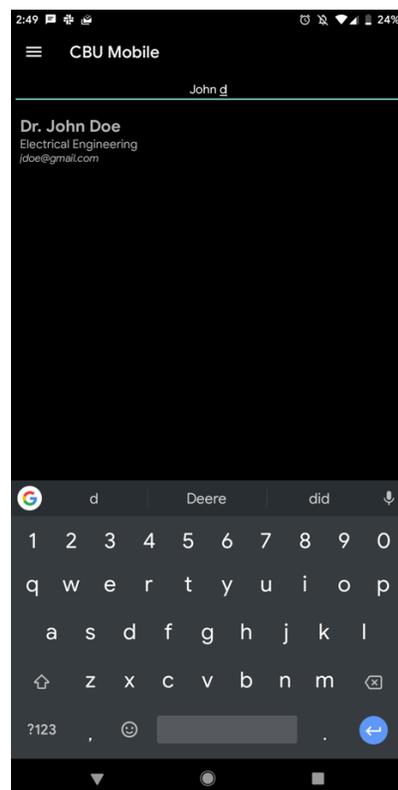


Fig. 7 Faculty Information

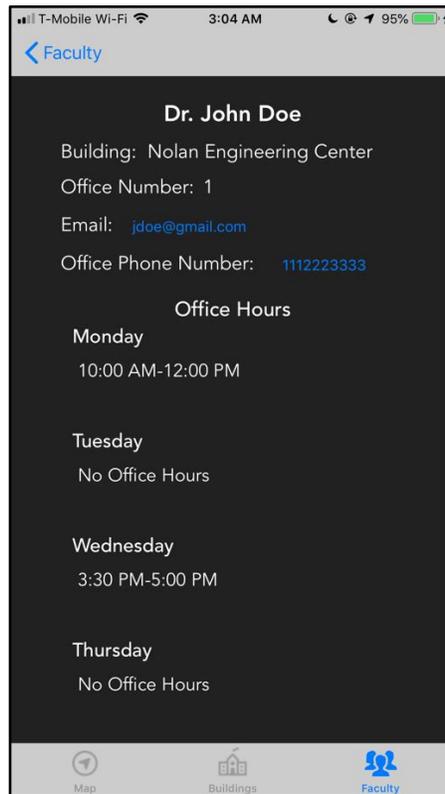


Fig. 8 iOS Layout



Fig. 9 Faculty Search iOS

