

# Indoor Navigation Using Spatial Anchors



In18-S7-CS4472 - Mobile Computing

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## 1. Introduction

An indoor navigation mobile application can help users navigate inside large complex buildings, such as hospitals, malls, airports, and office buildings using Augmented Reality (AR) technology. The goal of the application is to provide guidance to the user in searching and navigating locations of interest or amenities within a premise. To use the app, the users can launch it on their mobile device and point the device's camera at a location in the indoor space and select a **Destination** they want to visit and the app will provide navigation information using AR technology where users can navigate from **Waypoint** to **Waypoint** until they reach their **Destination**.

## 2. Use cases

Users and their respective use cases

- **Admin**: Manage user accounts
  - View/ create/ delete **Mapper** accounts
  - View/ create/ delete **Visitor** accounts
- **Mapper**: Creating indoor navigation information
  - Map the environment
  - View/ create/ delete **Waypoints** (Note: **Destination** inherits **Waypoint**)
  - Update neighboring **Waypoints** of a **Waypoint**
- **Visitor**: Navigate AR environment
  - View **Destinations**
  - Request the path to a **Destination**
  - Reset navigation

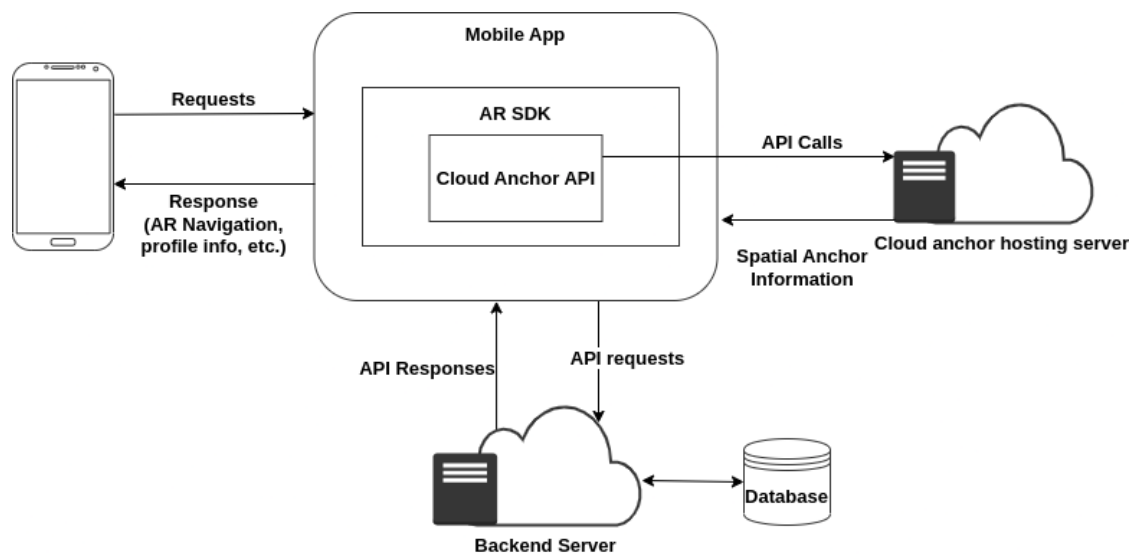
## 3. List of functionality/ requirements

- Cloud anchor support: The app should be able to create, store, and retrieve cloud anchors using Google Cloud Anchors API in order to accurately map the indoor environment.
  - Search functionality: The app should allow the user to search for specific **Destinations** of interest within the indoor environment and provide directions
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to those **Destinations**. The shortest path will be calculated based on the **Waypoints** and their neighbouring **Waypoints** using a graph search.

- AR support: The app should be able to display AR overlays or markers to help the user navigate within the indoor environment.
- User profile management: The app should allow users to create and manage user profiles

#### 4. High-level architecture



- Front-end: A renderer with AR support. Unity [1] can be used for this
  - AR Software Development Kit (SDK): A SDK that provides a set of APIs and tools to develop AR applications. Google's ARCore [2] can be used as the SDK for this
  - Cloud anchor API: A set of APIs that enable creating and resolving spatial anchors in the physical world. Google Cloud Anchors API [3] or Azure Spatial Anchors API [4] can be used as the API.
  - Cloud anchor hosting server: This is a server-side component that stores the anchor data and makes it available to mobile devices. The server would be responsible for managing the anchor data, including storing and retrieving it as needed. A Google Cloud Platform (GCP) [5] free trial can be used for hosting Google Cloud Anchors API services.
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- Backend server and database: This would be used to manage data related to the app, such as spatial anchor metadata and user profile data.

## 5. Deliverables

- An android mobile application for indoor navigation using spatial anchors with the usecases, and functionality/ requirements described above
  - Environment mapping using Cloud Anchors API
  - Managing **Waypoints** (including **Destinations**)
  - Calculate and display path from current **Waypoint** to **Destination**
  - User profile management
- Documentation and user guide

## 6. References

- [1] Unity Technologies, “Getting started with AR development in Unity,” *Unity3d.com*. [Online]. Available: <https://docs.unity3d.com/Manual/AROverview.html>. [Accessed: 18-Dec-2022].
- [2] “Overview of ARCore and supported development environments,” *Google Developers*. [Online]. Available: <https://developers.google.com/ar/develop>. [Accessed: 18-Dec-2022].
- [3] “ARCore cloud anchor management API,” *Google Developers*. [Online]. Available: <https://developers.google.com/ar/develop/cloud-anchors/management-api>. [Accessed: 18-Dec-2022].
- [4] “Spatial anchors,” *Microsoft.com*. [Online]. Available: <https://azure.microsoft.com/en-us/products/spatial-anchors/>. [Accessed: 18-Dec-2022].
- [5] “Google Cloud documentation,” *Google Cloud*. [Online]. Available: <https://cloud.google.com/docs>. [Accessed: 18-Dec-2022].
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