**CSE6224 SOFTWARE REQUIREMENTS ENGINEERING**

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**Tutorial Section: TT3L**

**Group No.: G3**

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# Introduction

## 1.1 Purpose

The purpose of the Campus Route Navigator (CRN) mobile application is to provide real-time, accessibility-focused navigation across the university campus. This software is designed to support individuals with mobility challenges, such as wheelchair users, elderly individuals, and those recovering from injury, by offering safe, inclusive, and optimized route planning.

This application serves as an assistive tool that integrates with the university’s existing Facilities Management System and Event Calendar System to dynamically reroute users based on live updates such as elevator outages, construction zones, and event-related closures. The CRN also empowers users to submit feedback or report obstacles, improving the platform’s responsiveness and adaptability over time.

The key purposes of the CRN are:

* To ensure every member of the university community can move independently and safely across the campus.
* To provide the fastest route between the user’s current location to the desired location avoiding unwanted events (considering events like construction, elevator outages and temporary accommodations for events.)
* To provide personalized navigation based on individual accessibility needs and preferences and real-time campus conditions.
* To provide the listing of all the events that are happening and will happen in campus.
* To assist in decision-making by delivering current updates on physical barriers and route disruptions by listing all the available routes between the user’s current location and desired destination.
* To enhance access to campus resources by allowing users to discover the availability of the facilities and accessibility of campus events with the events details directly from the app.
* To support continuous system improvement through user feedback mechanisms and usage analytics.
* To provide a platform for members to provide information about what is happening on the campus and report obstacles and submit feedback to the CRN.

This software operates as a mobile-only platform, available for Android and iOS devices, and requires institutional login credentials to ensure secure and personalized access.

## 1.2 Scope

The Campus Route Navigator (CRN) is a mobile-only application designed to improve campus accessibility by providing real-time, personalized navigation for individuals with mobility challenges. Operating on both Android and iOS devices, the system is intended to be used by students, staff, faculty, and visitors of the university who require assistance navigating around campus in a safe, efficient, and inclusive manner.

The CRN integrates with existing university systems, specifically the Facilities Management System and the Event Calendar System, to deliver real-time updates related to construction areas, elevator outages, and event-related closures. The system dynamically recalculates routes to reflect current campus conditions, ensuring that users are always provided with the safest and most accessible pathways.

**Campus Route Navigator will be able to perform the following functions:**

1. *Provide Accessible Route Planning Across Campus*

Generation of optimal navigation paths between two locations on campus, tailored to individual accessibility preferences (e.g., avoiding stairs, steep slopes).

1. *Provide Real-Time Updates*

Integration with live data sources to reflect dynamic changes such as construction, maintenance, or temporary inaccessibility.

1. *Facility Access Integration*

Allowing users to view available campus facilities and check their accessibility status.

1. *Event Integration*

Providing details about ongoing and upcoming campus events, along with accessible routes and accommodations.

1. *Feedback and Reporting Mechanisms*

Enabling users to report issues like blocked ramps, inaccessible areas, or other obstacles encountered during navigation.

1. *User Preferences*

Support for user-defined mobility preferences that influence route planning.

1. *Admin Dashboard*

A separate administrative interface (not part of the mobile app) for reviewing feedback, managing reports, and analysing system usage.

The CRN aims to provide a highly specialized, context-aware navigation experience that improves campus inclusivity and empowers individuals with diverse mobility needs to participate fully in campus life. Through continuous feedback collection and seamless system integration, CRN supports the university’s commitment to digital accessibility and user-cantered design.

The CRN system interacts with various user groups and integrates with external institutional systems to ensure effective, real-time, accessibility-aware campus navigation. Below is a detailed list of the primary stakeholders and external systems involved in the operation of CRN:

1. Students, Staff, and Visitors (End Users)

* Role: Primary users of the mobile application.
* Responsibilities:
  + Use the app for real-time navigation across campus.
  + Customize accessibility preferences for personalized route planning.
  + Provide real-world feedback, report accessibility issues (e.g., blocked ramps, faulty elevators), and suggest improvements to the system.
* Importance: Their interactions drive the core functionality and continuous improvement of the system.

1. University Events Calendar System

* Role: External system integrated with CRN.
* Responsibilities:
  + Supplies real-time data on upcoming and ongoing university events.
  + Provides information on temporary changes in access (e.g., venue closures, roadblocks, or crowd control).
  + Offers details on special accessibility arrangements (e.g., accessible seating, alternative entrances).
* Importance: Enables dynamic event-aware rerouting and enhances participation in campus activities.

1. University Facilities Management System

* Role: External system integrated with CRN.
* Responsibilities:
  + Delivers real-time updates on infrastructure changes, including:
  + Construction areas,
  + Maintenance activities,
  + Elevator functionality and outages.
* Importance: Provides essential input for dynamic routing to avoid inaccessible or disrupted areas.

1. Campus Maps and Infrastructure Plans

* Role: Foundational data source.
* Responsibilities:
  + Provides detailed digital layouts of:
  + Building locations,
  + Entrances and exits,
  + Elevators and staircases,
  + Ramps and pathways.
* Importance: Forms the basis for generating and optimizing accessible route paths within the mobile application.

1. University Administration and IT Department

* Role: System management and oversight.
* Responsibilities:
  + Manage and maintain system integration with campus databases and services.
  + Ensure user account creation, access control, and authentication using institutional credentials.
  + Update facility and event data sources regularly.
  + Monitor data security, privacy compliance, and system reliability.
* Importance: Ensures the system remains secure, updated, and aligned with university infrastructure and digital policies.

## 1.3 Product overview

### 1.3.1 Product perspective

This section provides an overview of the Campus Route Navigator (CRN) — a mobile-exclusive application developed to enhance real-time, accessibility-focused navigation across the university campus. It is specifically tailored for individuals with mobility challenges, including wheelchair users, elderly individuals, and those recovering from injury, ensuring they can move around campus independently, safely, and efficiently.

The CRN application leverages smart routing algorithms and real-time data integration to provide safe, dynamic, and inclusive routes. By combining static map infrastructure with live updates from Facilities Management and Event Management systems, CRN adapts instantly to changing campus conditions such as construction work, elevator outages, and event-related closures, enabling barrier-free movement.

A diagram of a computer program

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**Figure 1.1: System Overview Diagram**

**Mobile-Exclusive Platform:**

As a **mobile-only solution**, CRN is available on both **Android and iOS** smartphones. Users authenticate through **institutional credentials**, which enables personalized access and route customization based on individual accessibility preferences.

Once logged in, users access an **interactive, map-based interface** that provides step-by-step directions along accessible routes, highlights temporary obstacles, and offers alternative paths as needed.

**Relationship to Larger System:**

The CRN is an integrated module within the university's broader mobile service ecosystem, which includes digital campus services such as campus maps, student/staff portals, notification systems, facilities data, and event coordination tools. CRN extends these services by focusing specifically on **accessible navigation**.

Key enhancements provided by CRN include:

* **Accessibility-aware routing** based on user preferences and physical mobility requirements.
* **Live data integration** with construction updates and elevator outage reports.
* **Event-aware navigation**, offering reroutes and temporary accessibility accommodations.
* **Feedback collection** from users to support continuous system improvement.

**Core Functionalities of CRN (Mobile App):**

|  |  |
| --- | --- |
| **Feature** | **Description** |
| **Mobile-Based Accessible Route Planning** | Users can select origin, and destination points to receive optimized routes that avoid stairs, steep slopes, or inaccessible paths. |
| **Real-Time Campus Condition Updates** | CRN integrates with the Facilities Management system to receive real-time updates on construction, maintenance, and elevator outages. |
| **Event-Aware Navigation** | Uses the university's Event Calendar system to detect and reroute around temporary event setups, crowds, and accessibility arrangements. |
| **User Feedback Reporting** | Users can report route obstacles, issues, or make suggestions through the app. These reports influence live updates and future improvements. |
| **Personalized Accessibility Preferences** | Users can set personal navigation preferences (e.g., avoid steep slopes, prefer wide walkways) for more tailored guidance. |
| **Facility and Event Access** | Users can check real-time facility availability (e.g., accessible toilets, study areas) and see a live listing of ongoing or upcoming campus events. |
| **Admin and Analytics Dashboard (Back-End)** | Campus administrators can use a web-based back-end system to monitor user engagement, manage feedback, and analyse trends to improve campus accessibility. |

A diagram of a company

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**Figure 1.2: System Context Diagram**

Aligned with the university’s mission to promote digital inclusion, **Campus Route Navigator (CRN)** ensures that all members of the university community — particularly those with physical disabilities — can access timely, safe, and inclusive navigation services directly from their mobile devices. It addresses the **project purpose** of enabling safe, inclusive, and real-time campus navigation and aligns with the **project scope** by:

* Offering personalized, mobile-based navigation to users with mobility needs.
* Integrating with campus facilities and event systems to respond dynamically to real-world disruptions.
* Providing a user-centric feedback loop to enhance system responsiveness and adaptability.
* Ensuring campus members can independently plan and complete safe routes, access events, and locate accessible facilities in real time.

**Table 1.1: Goals of the System**

|  |  |  |
| --- | --- | --- |
| **Requirement ID** | **Goals** | **Author** |
| REQ\_CRN\_001 | The system shall make campus navigation easy and accessible for everyone. | Chun Yong |
| REQ\_CRN\_002 | The system shall ensure all users can move around campus safely and efficiently. | Chun Yong |
| REQ\_CRN\_003 | The system shall provide real-time updates on accessibility issues to help users make better navigation decisions. | Chun Yong |
| REQ\_CRN\_004 | The system shall allow users to report encountered problems and submit suggestions. | Chun Yong |
| REQ\_CRN\_005 | The system shall provide an interactive, user-friendly map-based navigation interface. | Chun Yong |
| REQ\_CRN\_006 | The system shall allow users to access available campus facilities through integration with the facilities system. | Chun Yong |
| REQ\_CRN\_007 | The system shall allow users to view current campus events and receive relevant event-based navigation updates. | Chun Yong |
| REQ\_CRN\_008 | The system shall generate personalized navigation routes based on user accessibility preferences (e.g., avoid stairs). | Chun Yong |
| REQ\_CRN\_009 | The system shall enable secure login using institutional credentials to ensure user data privacy and personalized access. | Chun Yong |
| REQ\_CRN\_010 | The system shall dynamically reroute users in response to live data such as elevator outages, construction, or event zones. | Chun Yong |
| REQ\_CRN\_011 | The system shall support continuous improvement by analysing user feedback and navigation data. | Chun Yong |

#### 1.3.1.1 System Interface

The **CRN** ("Campus Accessibility Navigation System") will primarily interact with users through a native mobile application designed for both iOS and Android operating systems. This mobile application will serve as the primary interface for accessing all features, including navigation, facility information, and event details.

TABLE 1.2: System Interfaces

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Interface ID** | **System Name** | **Description** | **Details** | **Author** |
| REQ\_SI001 | Campus Information System (CIS) | Retrieve and synchronize data related to Facility information and Event Data. | API-Driven Backend will handle data management and communication with external system | YEE SI SHUN |
| REQ\_SI002 | Mapping Services | Obtain base map data and potentially utilize routing algorithms. | Data Synchronization ensure data consistency of routing algorithms | YEE SI SHUN |
| REQ\_SI003 | Push notification Services | Send alerts and notifications to users regarding event reminders, accessibility updates, or important campus announcements. | Communication between mobile application and the backend API will utilize secure protocols | YEE SI SHUN |

#### 1.3.1.2 User Interfaces

The table below are the main features of each interface between the software product and its users.

TABLE 1.3: User Interfaces

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module ID** | **Module Name** | **Description** | **Priority** | **Author** |
| REQ\_UI001 | Navigation Interface | Display with accessible routes highlighted, search functional for locations, turn-by-turn navigation instructions. | High | TEE KAH LE |
| REQ\_UI002 | Facilities Information Interface | Display of facility details (e.g., building hours, accessible entrances, elevator locations, restroom accessibility), search and filtering options. | Medium | TEE KAH LE |
| REQ\_UI003 | Event Information Interface | Listing of campus events with accessibility information (e.g., wheelchair access, hearing loop availability), filtering by date, category, and accessibility features. | Medium | TEE KAH LE |
| REQ\_UI004 | User Profile/Preferences | Options for users to set their accessibility needs (wheelchair user, visually impaired) to personalize navigation and information filtering. | Medium | TEE KAH LE |
| REQ\_UI005 | Administrative Interface | Tools for administrators to manage map data, facility information, event details, and accessibility features. | High | TEE KAH LE |
| REQ\_UI006 | Reporting/Feedback Interface | For users to report accessibility issues or provide feedback on the system | Low | TEE KAH LE |

#### 1.3.1.3 Hardware interfaces

**CRN** needs the mobile devices with the specification described below so that the features work normally to user.

TABLE 1.4: Hardware Interfaces

|  |  |  |
| --- | --- | --- |
| **Interface ID** | **Description** | **Author** |
| REQ\_HI001 | The GPS/Location should be functional from user’s mobile device | CHANG HOE HIN |
| REQ\_HI002 | The Random Access Memory (RAM) required for the devices shall be at least 4GB | CHANG HOE HIN |
| REQ\_HI003 | The mobile should have touchscreen features for user interaction with the map and interface elements | CHANG HOE HIN |
| REQ\_HI004 | The camera of mobile device can be use for image recognition features | CHANG HOE HIN |

#### 1.3.1.4 Software interfaces

**CRN** also requires other software to function properly. The interfaces between CRN and other software are described below:

TABLE 1.5: Software Interfaces

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ID** | **Category** | **Name** | **Version Number** | **Purpose** | **Reference** |
| REQ\_SI001 | Operating System | Android | Android 9.0 or later | Software platform that manages user device hardware | Google Chrome Browser |
| iOS | iOS 15.0 or later |

#### 1.3.1.5 Communications interfaces

The table below outlines the various interfaces to communications, specifying the protocols and methods the system will use to interact with other systems, networks, and services.

TABLE 1.6: Communications Interfaces

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Interface ID** | **Description** | **Protocols/Methods** | **Priority** | **Author** |
| REQ\_CI001 | Communication with backend server and external services. | TCP/IP, HTTP/HTTPS | High | YEE SI SHUN |
| REQ\_CI002 | Fetch data about facilities, events, and map information from campus systems third-party providers. | RESTful, GraphQL | High | YEE SI SHUN |
| REQ\_CI003 | Structuring the data exchanged over APIs. | JSON, XML | Medium | YEE SI SHUN |
| REQ\_CI004 | Communication with beacons or other nearby devices for indoor navigation or proximity-based information. | BLE | Medium | YEE SI SHUN |
| REQ\_CI005 | Deliver real-time updates about events or accessibility alerts | Firebase Cloud Messaging, APNs | Low | YEE SI SHUN |

#### 1.3.1.6 Memory

The Memory Constrains for **CRN** are described in the table below:

TABLE 1.6: Memory

|  |  |  |  |
| --- | --- | --- | --- |
| **Constraint ID** | **Memory Name** | **Description** | **Author** |
| REQ\_MC001 | Device Storage | Caching map tiles, user preferences and potentially downloaded event information. | YEE SI SHUN |
| REQ\_MC002 | Backend Database | Persistent storage of map data, facility details, event schedules, user accounts, and accessibility information. | YEE SI SHUN |
| REQ\_MC003 | In-memory Caching | Frequently accessed data to improve performance | YEE SI SHUN |

#### 1.3.1.7 Operations

The Operations of **CRN** are described below:

1. User Operations
   1. Searching for a specific building or location.
   2. Requesting accessible directions between two points.
   3. Filtering facilities by accessibility features.
   4. Viewing details about a specific facility or event.
   5. Saving favourite locations or events.
   6. Reporting an accessibility issue.
2. System Operations
   1. Fetching and displaying map data.
   2. Calculating accessible routes based on user preferences.
   3. Retrieving and updating facility and event information from external systems.
   4. Sending push notifications for event reminders or accessibility alerts.
   5. Processing user feedback and reports

#### 1.3.1.8 Site adaption requirements

The Site adaption requirements for **CRN** are described in the table below:

TABLE 1.7: Site adaption requirements

|  |  |  |  |
| --- | --- | --- | --- |
| **Constraint ID** | **Type** | **Description** | **Author** |
| REQ\_SAR001 | Campus Map Data | Accurate and detailed map including building layouts, pathways, accessible entrances, elevators, ramps, and accessible restrooms. | TEE KAH LE |
| REQ\_SAR002 | Facility Information | Comprehensive data about each building and facility, including accessibility features, hours of operation, contact information, and potentially images or floor plans | TEE KAH LE |
| REQ\_SAR003 | Event Data Integration | Pull Event Information from the campus calendar system, including location, time, and accessibility details. | TEE KAH LE |
| REQ\_SAR004 | Accessibility Data Standards | Adherence to any campus-specific or regional accessibility guidelines and standards. | TEE KAH LE |
| REQ\_SAR005 | Integration with Campus Services | Details on how the system might interact with other campus services. (e.g., transportation, emergency services). | TEE KAH LE |

#### 1.3.1.9 Interfaces with services

The Interface with Services of CRN is described below:

TABLE 1.8: Site adaption requirements

|  |  |  |  |
| --- | --- | --- | --- |
| **Interfaces ID** | **Services Name** | **Description** | **Author** |
| REQ\_IS001 | Mapping Services | Base map data and potentially routing algorithms. (e.g., Google Maps, Mapbox) | YEE SI SHUN |
| REQ\_IS002 | Campus Information Systems | Retrieve real-time data. (APIs for facilities, events, directories) | YEE SI SHUN |
| REQ\_IS003 | Push Notifications Services | For delivering alerts and updates. (e.g., Firebase Cloud Messaging, APNs) | YEE SI SHUN |
| REQ\_IS004 | Analytics Services | Track usage and identify areas for improvement. (e.g., Google Analytics) | YEE SI SHUN |
| REQ\_IS005 | Authentication Services | For user login and security | YEE SI SHUN |

### 1.3.2 Product functions

A diagram of a user interface

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**Figure 1.3: Use Case Diagram of CRN**

#### 1.3.2.1 End Users

A diagram of a person with text

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**Figure 1.4: Use Case Diagram of Actor (End Users)**

**Table 1.9: Use Case Diagram of Actor (End Users)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Use Case ID** | **Use Case Name** | **Description** | **Author** |
| REQ\_UCEU001 | Set Preference | Tailor navigation to individual accessibility needs. | Hoe Hin |
| REQ\_UCEU002 | Report Obstacles | Notify campus authorities about accessibility issues. | Hoe Hin |
| REQ\_UCEU003 | Submit feedback | Share user experiences to enhance system functionality. | Hoe Hin |
| REQ\_UCEU004 | Enter destination/starting location | Able to plan routes efficiently. | Hoe Hin |
| REQ\_UCEU005 | Log in | Allow end users to securely log in into the platform and access personal preferences. | Hoe Hin |
| REQ\_UCEU006 | Select available route | End users able to choose the best route based on real-time data. | Hoe Hin |
| REQ\_UCEU007 | View/check campus facilities | Access details about facilities and check their accessibility status. | Hoe Hin |

#### 1.3.2.2 Admin

A diagram of a person with text

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**Figure 1.5: Use Case Diagram of Actor (Admin)**

**Table 1.10: Use Case Diagram of Actor (Admin)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Use Case ID** | **Use Case Name** | **Description** | **Author** |
| REQ\_UCA001 | Review feedback | Administrator can access and review feedback submitted by end users. | Hoe Hin |
| REQ\_UCA002 | Validate End Users’ reports | Verify the accuracy of reported obstacles | Hoe Hin |
| REQ\_UCA003 | Edit events | Admin able to add, modify, or remove events | Hoe Hin |

### 1.3.3 User characteristics

This section describes the basic understanding and expected knowledge from end users of the system as it will affect **CRN** software performance. The following table illustrates the expected level for each role.

TABLE 1.11: User characteristics

|  |  |  |
| --- | --- | --- |
| **Role** | **Consideration** | **Expected Knowledge** |
| Students | Basic Smartphone Usage | Familiarity with downloading and using mobile applications, navigating interfaces. |
| General Digital Literacy | Comfortable with searching for information online, using digital maps, and interacting with digital services. |
| Faculty and Staff | Moderate Digital Literacy | Comfortable using various digital tools for work and communication |
| Familiarity with Campus Resources | Generally, possess a good understanding of campus buildings, facilities, and potentially event locations relevant to their work. |
| Visitors | Basic Smartphone Usage | Like students |
| Limited or No Campus Familiarity | Will likely have no prior knowledge of campus layout, building names, or where to find specific facilities or events. |
| Administrators and Campus Management | High Digital Literacy | Expected to be proficient in using various software applications and digital platforms |
| Comprehensive Campus Knowledge | Possess detailed knowledge of campus infrastructure, facilities, and event management processes. |
| System-Specific Knowledge | Require training and documentation on how to use an administrative interface for managing data within the system. |

### 1.3.4 Limitations

CRN faces also several limitations that could impact its functionality and effectiveness. These include:

**1)Accuracy and Completeness of Data:**

* **Map Data:** The accuracy of the base map and the overlays for accessible routes and features will depend on the available data and the effort put into mapping.
* **Facility Information:** Heavily reliance regular updates from facility management. Information could be outdated or incomplete.
* **Event Information:** Not all events might have detailed accessibility information available.

**2)Real-time Updates:**

* **Dynamic Obstacles:** Construction, spills, or unexpected closures are no way to record unless there's a mechanism for immediate reporting and updating.
* **Event Changes:** Last-minute event changes or cancellations might not be reflected instantly in the system.

**3)Indoor Navigation Accuracy:**

* GPS signals are often weak or unavailable indoors.

**4)Network Dependency:**

* Functionality might be limited or unavailable in areas with poor connectivity as software performance depends on stable connectivity.

## 1.4 Definitions

Below are terms, phrases and words used in the document and its related definition:

**Table 1.12: Definition**

|  |  |
| --- | --- |
| **Terms** | **Definition** |
| Campus Route Navigator / CRN | A digital platform that provides navigation system for campus and provides event info’s. |
| End Users | Includes faculty, staff, visitor and student. |
| Institutional Login Credentials | ID and password provided by university. |
| Live Data Sources | Databases that provide real-time or near-real-time information. |
| User-centered | System whose designs is based on the ways that people will use them and what they will do with them. |
| Dynamic Routing | Automatically choose preferred route depends on current conditions such as congestion, availability. |

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# Requirements

## 3.1 Functions

## 3.2 Performance requirements

## 3.3 Usability requirements

## 3.4 Interface requirements

## 3.5 Logical database requirements

## 3.6 Design constraints

## 3.7 Software system attributes

## 3.8 Supporting information

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## 4.5 Logical database requirements

## 4.6 Design constraints

## 4.7 Software system attributes

# Appendices

### 5.1 Assumptions and dependencies

**Assumptions:**

These are things you are taking for granted to be true during the development and operation of the system. If these assumptions prove incorrect, it could impact the system's functionality or viability.

* **Availability and Accuracy of Campus Data:**
  + It is assumed that the relevant campus information systems (for facilities and events) will provide reliable and up-to-date data through their APIs or other integration methods.
  + We assume that the data provided by these systems regarding accessibility features is accurate and consistently formatted.
  + It is assumed that a reasonably accurate and detailed digital map of the campus is available and can be integrated into the system.
* **User Device Capabilities:**
  + We assume that the majority of target users will have smartphones with sufficient processing power, storage, and connectivity (cellular or Wi-Fi) to run the mobile application effectively.
  + It is assumed that user devices will have functional GPS capabilities for location services.
* **User Willingness and Ability to Use the System:**
  + We assume that users will be willing to download and use the mobile application.
  + We assume a basic level of digital literacy among the target user groups.
  + We assume users will provide necessary permissions (e.g., location access) for the application to function correctly.
* **Network Connectivity:**
  + We assume that users will generally have access to a reliable network connection (Wi-Fi or cellular data) on campus to utilize the real-time features of the application.
* **Third-Party Service Availability:**
  + We assume the continued availability and stable operation of any third-party services integrated into the system (e.g., mapping services, push notification services).
* **Adherence to Accessibility Standards:**
  + We assume that the campus infrastructure (e.g., ramps, elevators, accessible restrooms) is maintained according to relevant accessibility standards. The system will reflect this, but its effectiveness relies on the physical environment being as described.

**Dependencies:**

These are external factors or components that your system relies on to function correctly. If these dependencies are not met, the system's development or operation could be hindered.

* **Integration with Campus Information Systems:** The system's ability to provide up-to-date facility and event information is directly dependent on successful and maintained integration with the campus's existing data systems. Changes to these systems or their APIs could impact the navigation system.
* **Availability of Accurate Map Data:** The core navigation functionality relies on having access to a detailed and accurate digital map of the campus. The quality and format of this data are crucial dependencies.
* **Functionality of User Devices:** The mobile application's performance and features are dependent on the hardware and software capabilities of the users' devices (operating system version, GPS accuracy, etc.).
* **Network Infrastructure:** Real-time features and access to online data are dependent on the availability and reliability of the campus network infrastructure and users' data plans.
* **Third-Party Service APIs:** The system's functionality may depend on the APIs provided by external services (e.g., mapping services for displaying maps and potentially routing). Changes or disruptions to these APIs could affect the system.
* **User Adoption and Feedback:** The long-term success and improvement of the system depend on users adopting it and providing feedback on its usability and accuracy.
* **Maintenance and Updates:** The system requires ongoing maintenance and updates to ensure data accuracy, compatibility with new devices and operating systems, and the implementation of improvements and bug fixes. This is dependent on the availability of resources and personnel.