Software Requirements Specification for Software Engineering: subtitle describing software

Team #2, Campus Connections
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Revision History

Date	Developer(s)	Change
Oct 2	Zihao Du	Add Section 6, 7, 8 Revision 0
Oct 2	Matthew Miller	Add Section 1, 5, 13, 16 Revision 0
Oct 2	Michael Kim	Add Section 15 Revision 0
Oct 2	Waseef Nayeem	Add Section 3, 19 Revision 0

1 Purpose of the Project

1.1 User Business

The project being outlined in this document is an social media application with location-specific features for McMaster University to allow the university's students to connect with each other. The project will allow for interaction between users, in addition to allowing users to find information on different parts of the main campus of McMaster University, including on-campus events and room availability in buildings.

1.2 Goals of the Project

1.2.1 **Accurate Data Collection** The product must collect location and directional data to accurately ascertain the position of the user in the building and campus. This will allow the user to interact with the system and other users of the product to enhance social interactions. The error of data must be less than 5

1.2.2 **Ease of Use** The product must be user friendly and convenient to use, as many university applications are not used or underused due to the complexity and difficult operation. The end user must be able to easily download and learn the application without external guidance. At least 90

1.2.3 **Availability** The product must be able to support its users unless there is a planned maintenance or external failures. This is important as the product is using real-time data and significant delays or downtimes will impact the accuracy and usability of the product.

1.2.4 **Reliable Data Communication** The product must have good and secure data communication to support the real-time nature of the product. This is important as the product is using real-time data and significant delays will impact the accuracy and usability of the product. The product must be able to provide the desired output within 5 seconds with good university WiFi connection.

1.2.5 **Protection of Personal Information** The product must keep all personal data provided by users secure in the database. Personal data

will be collected securely and only used for product functions. The application must support the removal of user data upon request. This is important because users will complete a consent form that acknowledges their privacy.

1.2.6 **User Communication** The product must be able to support user-to-user communication. It should provide a friend system for users to add new friends, send messages and emojis to friends and share current location and status (in lecture/event or free) with their friends. This is important because the main purpose of the project is to allow users to connect with peers effectively.

1.2.7 **Interactable Campus Buildings** The product must be able to provide interactions between users and campus buildings. It must show the availability of the lecture halls and information about ongoing events in a building since one of the purposes of the project is to help users utilize campus resources effectively.

1.2.8 **Immersive User Experience** The product should provide an immersive user experience to the users with some XR technologies. At least 90should find the product much more attractive and immersive than other university applications when conducting the user survey. An immersive user experience is one of the unique selling points of our product.

2 Stakeholders

2.1 Client

Insert your content here.

2.2 Customer

Insert your content here.

2.3 Other Stakeholders

Insert your content here.

2.4 Hands-On Users of the Project

Insert your content here.

2.5 Personas

Insert your content here.

2.6 Priorities Assigned to Users

Insert your content here.

2.7 User Participation

Insert your content here.

2.8 Maintenance Users and Service Technicians

Insert your content here.

3 Mandated Constraints

3.1 Solution Constraints

- **Description:** The product shall be a mobile application.
  Rationale: A mobile application is the most feasible option for the anticipated user environment.
  Fit Criterion: The produced application can successfully be installed and run on modern mobile devices.

Insert your content here.

3.2 Implementation Environment of the Current System

- Modern mobile operating systems.

- Hardware sensors for telemetry data capture.

- Hardware device for visual data capture.

- Network/Internet interface.

- Variable external physical environement.

3.3   Partner or Collaborative Applications

N/A

3.4   Off-the-Shelf Software

N/A

3.5   Anticipated Workplace Environment

- The product shall be used on the campus of McMaster University.

- The product shall be used under various lighting conditions.

- The product shall be used inside buildings as well as outdoors.

3.6   Schedule Constraints

- The proof-of-concept shall be ready to demonstrate by Nov. 13-24, 2023.

- Revision 0 shall be complete and demonstrated by Feb. 5-16, 2024.

- The final product shall be complete and demonstrated by Mar 18-29, 2024.

3.7   Budget Constraints

- The project budget must not exceed $750 CAD. The sole source of any funding shall be the team itself.

3.8   Enterprise Constraints

N/A

4 Naming Conventions and Terminology

4.1 Glossary of All Terms, Including Acronyms, Used by Stakeholders involved in the Project

Term	Definition
Campus Connections	Campus Connections is the name of the company the capstone project team runs and the name of the application
Extended reality (XR)	AR technology combines the physical world with a "digital twin world" able to interact with it
OSCARplus	OSCARplus is is an appointment, registration and job posting system for McMaster students and alumni
Unified Model Language (UML) diagram	UML diagram is a graphical notation used to construct and visualize object oriented system
Personal Identification Information (PII)	Personal data that could potentially identify a specific individual
Unity	Unity is a cross-platform game engine developed by Unity Technologies

Table 1: Naming Conventions and Terminology

5 Relevant Facts And Assumptions

5.1 Relevant Facts

- The two main platforms for AR are ARKit by Apple for Apple devices, and ARCore by Google for Android devices

5.2 Business Rules

-

5.3 Assumptions

-

6   The Scope of the Work

6.1   The Current Situation

Currently, students do not have effective ways to connect with peers of same interest and resources available on campus. One of the most accessible tools for students to utilize campus resources is OSCARplus. However it is for McMaster students and Alumni only, and does not support interactions between users – users cannot see if their friends and classmates are joining the events nor send/read comments from others.

As for room availability information, there is no official management system for visitors and students. Students always occupy empty rooms their found to meet with friends and classmates. Due to poor management and messy process, it is usually very difficult to find an appropriate place for team discussion and club events.
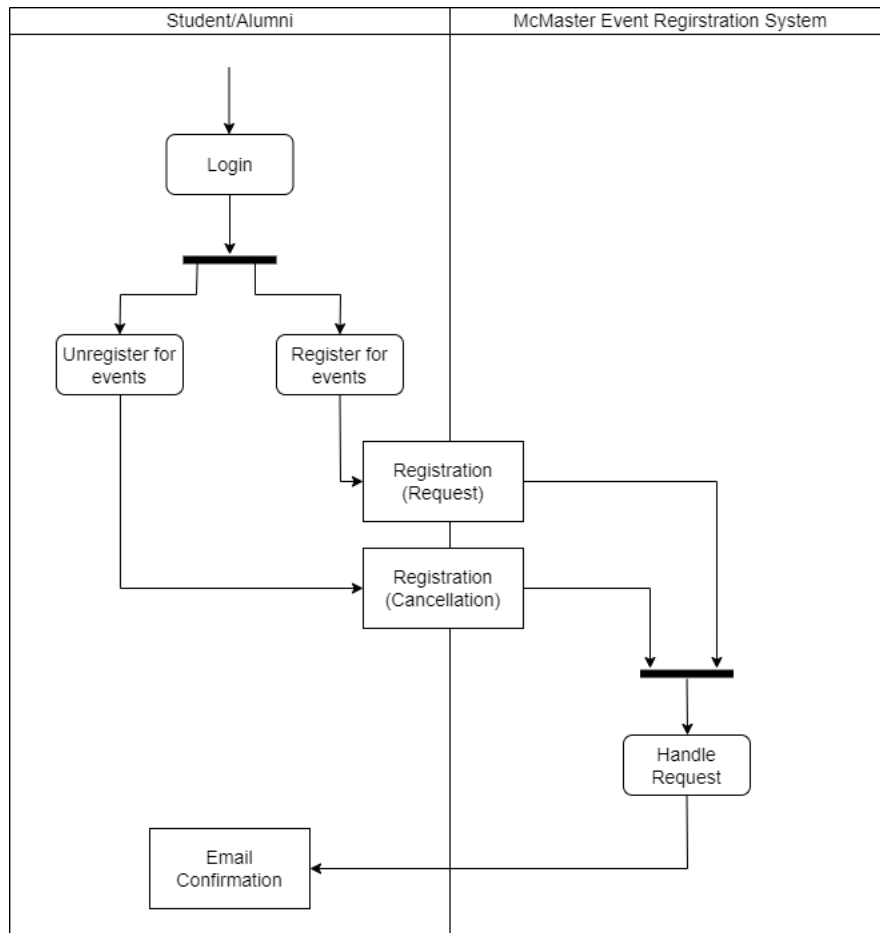
Figure 1: Context Diagram

6.2 The Context of the Work

The context diagram depicted below illustrates the interactions of the system with adjacent external systems and services.
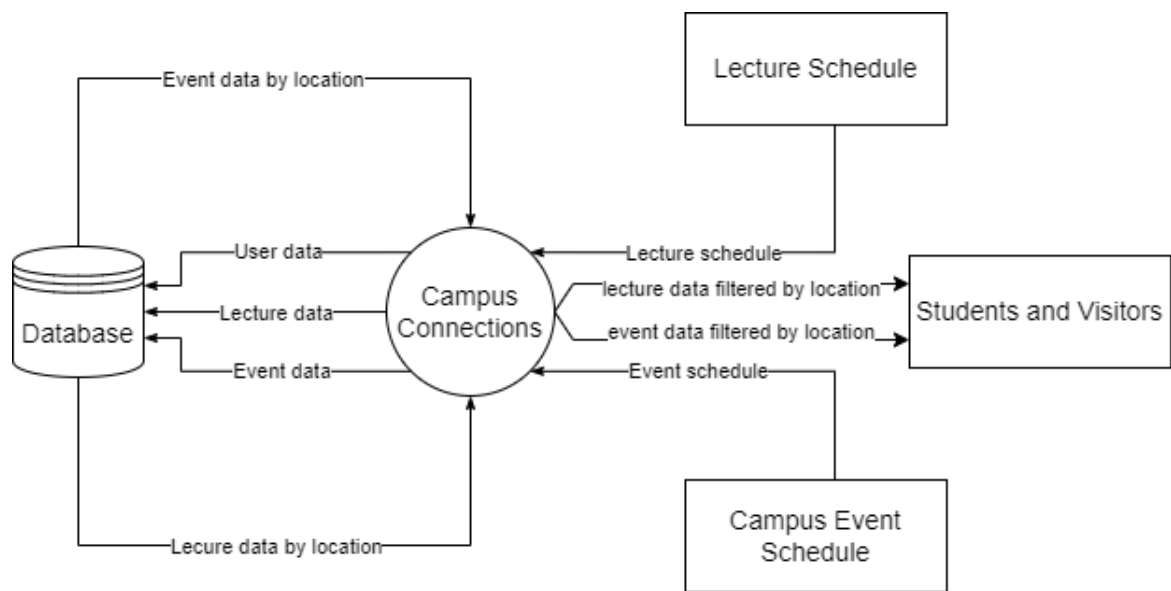
Figure 2: Current Event Registration Situation

6.3 Work Partitioning

Event Name	Input/Output	Summary
Provide lecture schedule	IN: Lecture schedule	Give schedule of lectures when there is an update and after every semester
Provide event schedule	IN: Event schedule	Give schedule of campus events periodically and when there is an update
Record user data	OUT: User data	Record user related data, including user settings, user friends and registered events
Record lecture data	OUT: Event data	Record lecture data, including lecture name, time, duration and location
Record event data	OUT: Event data	Record event data, including event name, time, duration and location
Display event schedule	IN: event data, OUT: event data filtered by location	Display events that are going to be held in in a given building
Display lecture schedule	IN: lecture data, OUT: lecture data filtered by location	Display lectures that are going to be held in in a given building

Table 2: Business Event List

6.4 Specifying a Business Use Case (BUC)

The following is an activity diagram for the Display event schedule process. The trigger of this business user case will be user interaction, and input will

be campus event data from database. What will be displayed is a schedule of events held inside a specific building with detailed event information.
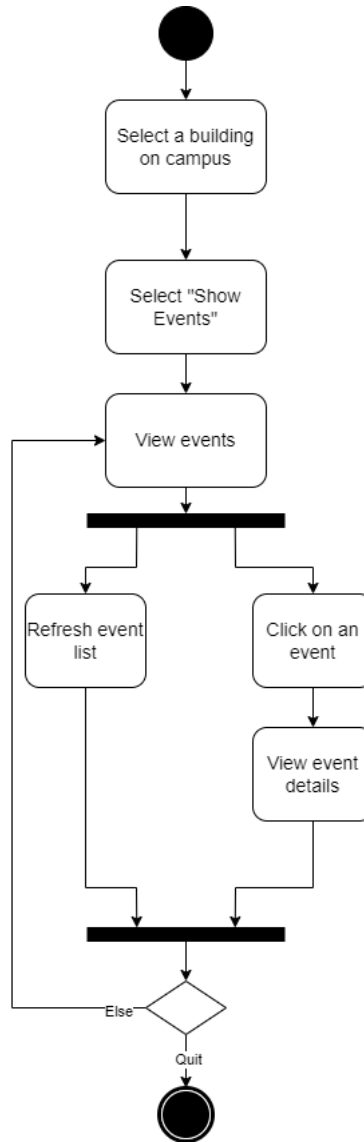
Figure 3: Activity diagram for Display Event Schedule Process

7 Business Data Model and Data Dictionary

7.1 Business Data Model

The following UML class diagram shows all types of business data that will be used in this project.

All the classes represent corresponding business data, all these entries and their attributes will be defined and explained in the data dictionary. class are defined in the data dictionary.
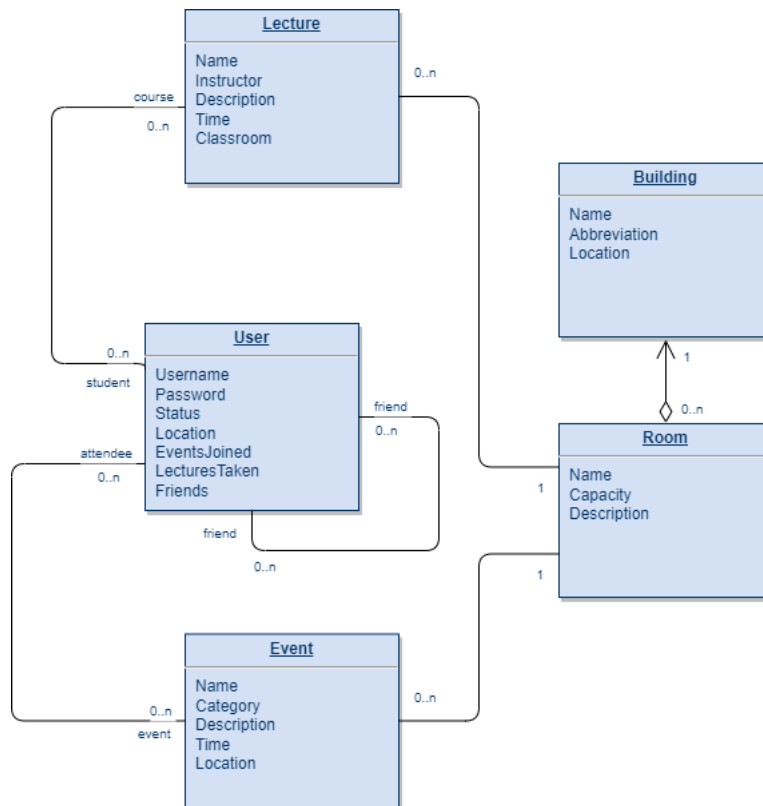
Figure 4: UML class model

7.2 Data Dictionary

This section will include definition of all classes in UML class model and their attributes. Some self-explanatory attributes like name will be ignored.

Name	Content	Type
Lecture	McMaster course data	Class
Lecture.Instructor	Course instructor	Attribute
Lecture.Time	Course schedule	*HH/MM/SS 24 hour clock*
Lecture.Classroom	Course location	Room
Event	McMaster on-campus event data	Class
Event.Category	Held by which department	Attribute
Event.Time	Event time	*HH/MM/SS 24 hour clock*
Lecture.Location	Event location	Room
User	User account data, friends data, location, event & lecture attendance	Class
User.Location	Geographic location	Attribute
User.Status	Online or not	Boolean, Attribute
User.EventsJoined	List of event	Event, Attribute
User.LecturesTaken	List of lecture	Lecture, Attribute
User.Friends	List of friends	User , Attribute
Building	McMaster main campus building	Class
Building.Abbreviation	Abbreviation of building name	Attribute
Building.Location	Geographic location	Attribute
Room	Room inside a building	Class
Room.Capacity	Room capacity	Number, Attribute

Table 3: Data Dictionary

8 The Scope of the Product

8.1 Product Boundary

The use case diagram depicted below identifies the boundaries between the users and the product.
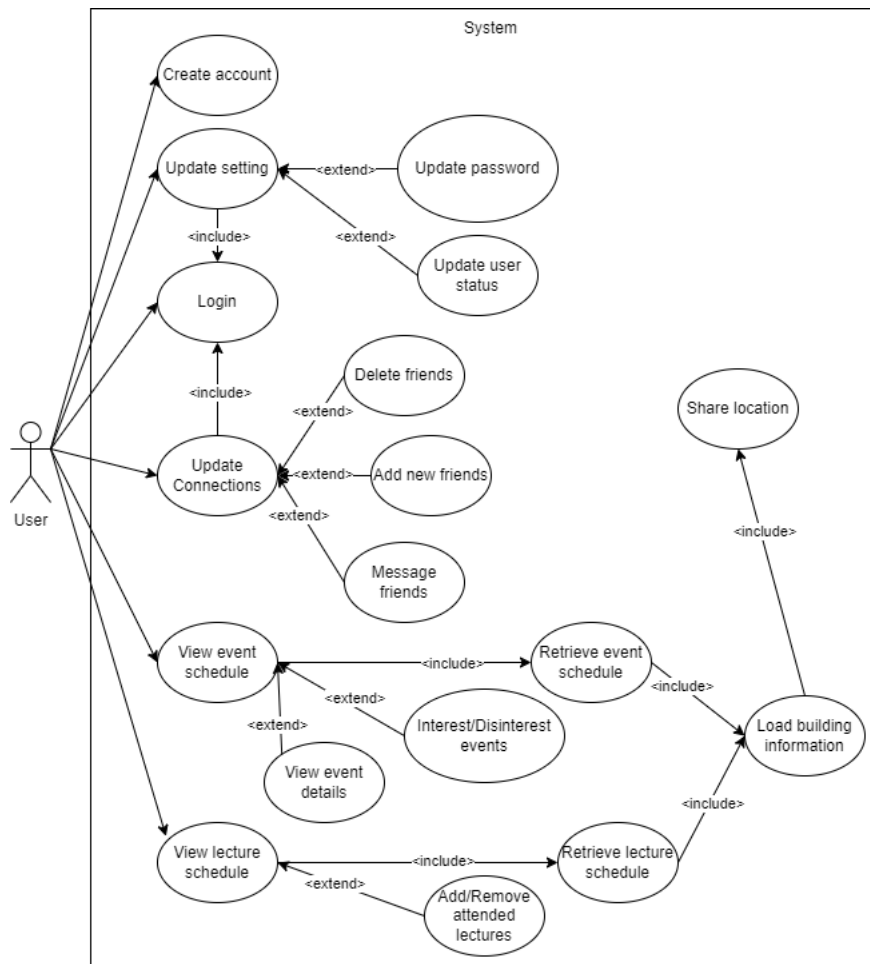
Figure 5: Use Case Diagram

8.2 Product Use Case Table

PUC No	PUC Name	Actor/s	Input & Output
1	Create Account	User	Username & Password (in)
2	Update Password	User	Username & New Password (in)
3	Update User Status	User	New Status (in)
4	Login	User	Username & Password (in), Response message (out)
5	Add New Friend	User	Friend Username (in), Friend Request (out)
6	Delete Friend	User	Friend Username (in), Confirmation Message (out)
7	Message Friend	User	Message Content (in), Message Sent Notification (out)
8	View Event Details	User	User Interaction (in), Event details (out)
9	Interest/Disinterest Event	User	User Interaction & Event Name (in)
10	Add/Remove attended lecture	User	User Interaction & Lecture Name (in)
11	Retrieve Event Schedule	System	New Schedule (out)
12	Retrieve Lecture Schedule	System	New Schedule (out)
13	Load Building Information	System	Location & Sensor data (in), Building Name (out)

Table 4: Product Use Case

8.3 Individual Product Use Cases (PUC's)

Use case #1: Create Account
Precondition: None
Trigger: The user clicks on create account button
Outcome

1. User provides the required information

2. System verifies all required information has been provided

3. System securely registers user information

4. User is redirected back to the Home page

Postcondition: The user has successfully created an account and account information is stored and secured in a database.

Use case #2: Update Password
Precondition: The user has already created an account
Trigger: The user clicks on change password button
Outcome

1. User navigates to change password page

2. User provides old password

3. User provides new password

4. System verifies old password is correct and new password is valid

5. System updates password of current user in the database

6. User is redirected back to the Home page

Postcondition: The user has successfully changed the password.

Use case #3: Update User Status
Precondition: The user has already created an account
Trigger: The user clicks on change status button
Outcome

1. User navigates to change status page

2. User updates status to a new status

3. System updates user status and redirects back to the Home page

Postcondition: The user status has been changed successfully.

Use case #4: Login
Precondition: The user has already created an account
Trigger: The user clicks on login button on the home page
Outcome

1. User navigates to login page

2. System verifies all required information has been provided and matches the database record

3. User is redirected to the home page as alogged-in user

Postcondition: The user has successfully logged in to the created account with all settings and connections loaded from the database.

Use case #5: Add New Friend
Precondition: The user has already logged in
Trigger: The user searches for another user and sends a friend request
Outcome

1. User searches for another user

2. User sends a friend request

3. System sends the request and user information to the destined user

4. Destined user accepts/rejects the request

5. User receives a notification

Postcondition: The user gets a new connection in their friends list.
Postcondition 2: The user is rejected and gets a notification about that.

Use case #6: Delete Friend
Precondition: The user has already logged in and has at lease one friend
Trigger: The user clicks delete button on friend page
Outcome

1. User searches for a friend

2. User deletes the friend

3. System sends a confirmation prompt

4. User continues to delete

5. User receives a notification

Postcondition: The friend is deleted from user's friends list.

Use case #7: Message Friend
Precondition: The user has already logged in and has at lease one friend
Trigger: The user texts a friend on friend page
Outcome

1. User searches for a friend

2. User start to text the friend

3. System sends message to the destined friend

Postcondition: The friend receives a message from the user.

Use case #8: View Event Details
Precondition: The user has already logged in and necessary sensors are working properly
Trigger: The user clicks on an event
Outcome

1. User moves the device to target a building on campus

2. User finds a list of events

3. User clicks on one of the event

4. System displays more information about the event

Postcondition: The content, time and location of the event are displayed.

Use case #9: Interest/Disinterest Event
Precondition: The user has already logged in and had a target building
Trigger: The user clicks on interest/disinterest button
Outcome

1. User browses the event list of the target

2. User navigates to an event detail page with a specific name

3. User clicks on the corresponding button

4. System sends the request to the database

5. System displays the new state of the event

Postcondition: The user event list in the database is updated and the UI changes correspondingly.

Use case #10: Add/Remove Attended lecture
Precondition: The user has already logged in and had a target building
Trigger: The user clicks on add/remove button
Outcome

1. User browses the lecture list of the target

2. User navigates to a lecture detail page with a specific course code

3. User clicks on the corresponding button

4. System sends the request to the database

5. System displays the new state of the lecture

Postcondition: The user lecture list in the database is updated and the UI changes correspondingly.

Use case #11: Retrieve Event Schedule

Precondition: None
Trigger: A request to update schedule is sent or trigger by the system timer
Outcome

1. System sends a request to the on-campus schedule interface

2. System gets the up-to-date schedule

3. System stores the new schedule to the database

Postcondition: The new schedule is stored in the database and will be utilized later.

Use case #12: Retrieve Lecture Schedule
Precondition: None
Trigger: A request to update schedule is sent or trigger by the system timer
Outcome

1. System sends a request to lecture schedule interface

2. System gets the up-to-date schedule

3. System stores the new schedule to the database

Postcondition: The new schedule is stored in the database and will be utilized later.

Use case #13: Load Building Information
Precondition: Location share is allowed and sensors are set properly
Trigger: A request for event/lecture schedule is sent by the user
Outcome

1. System gets geographic location and sensor data from the device

2. System finds the most likely building on campus

3. System displays building information

Postcondition: The system provides information of the building the user locates now.

9 Functional Requirements

9.1 Functional Requirements

Insert your content here.

10 Look and Feel Requirements

10.1 Appearance Requirements

Insert your content here.

10.2 Style Requirements

Insert your content here.

11 Usability and Humanity Requirements

11.1 Ease of Use Requirements

Insert your content here.

11.2 Personalization and Internationalization Requirements

Insert your content here.

11.3 Learning Requirements

Insert your content here.

11.4 Understandability and Politeness Requirements

Insert your content here.

11.5 Accessibility Requirements

Insert your content here.

12 Performance Requirements

12.1 Speed and Latency Requirements

Insert your content here.

12.2 Safety-Critical Requirements

Insert your content here.

12.3 Precision or Accuracy Requirements

Insert your content here.

12.4 Robustness or Fault-Tolerance Requirements

Insert your content here.

12.5 Capacity Requirements

Insert your content here.

12.6 Scalability or Extensibility Requirements

Insert your content here.

12.7 Longevity Requirements

Insert your content here.

13 Operational and Environmental Requirements

13.1 Expected Physical Environment

- The product will be installed on the user's smartphone (iPhone or Android) and be used around the main campus of McMaster University

13.2 Wider Environment Requirements

- The product must interface with the latest three major releases of iOS and Android OS (as of October 2023)

13.3 Requirements for Interfacing with Adjacent Systems

-

13.4 Productization Requirements

-

13.5 Release Requirements

- The product must be downloadable through the App Store and Google Play Store

14 Maintainability and Support Requirements

14.1 Maintenance Requirements

Major updates could be rolled out during periods of reduced usage such as Reading Week, after exams, or Spring semester. This will allow significant time to stablize the update and test them before the updates are applied to the users.

Additionally, the administrator can perfrom maintenance on the database and server to check the correct operation of the product. This will maximize the availability of the product.

14.2 Supportability Requirements

Feature requests or issues can be sent to the product GitHub. These opened issues will be discussed by the maintainers and communicated through the issue on how they will be dealt with.

A user manual will be complied and stored in the GitHub, this manual will be updated with Frequently Asked Questions and other entries as additional

features are introduced. The application will direct users to this manual in the menu.

14.3 Adaptability Requirements

This product will be accessible in Android 13 and above. (???) This product will be accessible in Windows 10 and above.

This product may be ported to other universities in Ontario, Canada, or other countries. Although the product is designed to work for university, this can be porte to other large events and buildings to help users navigate and coordinate better.

15 Security Requirements

15.1 Access Requirements

There will be three levels of access.

The first will be before login and account creation, where anyone can access. They must not have access to anything beyond the login, account creation, and account recovery pages.

The second will be after login that verifies their identity, where the user has provided information matching the McMaster student or faculty member with McMaster email account. Only the user can access this page.

The third level will the the administrator account, used for adding, deleting, or editing official events. This account can be accessed by login that verifies that they are the maintainer, this will be used by the maintainers to check the functionality of the product and pull logs that are not accessible to users.

15.2 Integrity Requirements

The product will prevent introduction of duplicate data, to guarantee that all user identities are unique.

In the future, the database and server can protect itself from excessive use with a load balancer and additional servers being added.

15.3 Privacy Requirements

All data collected must be encrypted on disk in the server by standard encryption algorithm. All data collected must be encrypted on transit by industry standard encryption algorithm.

The product will require users to agree on the terms prior to account creation and additional data submission. The product must erase all data if the user requests, or when account is deleted. Additionally, accounts that are inactive for a certain period of time will have their account deleted after notice to prevent unnecessary data being held.

15.4 Audit Requirements

N/A (This currently does not apply, once the product is ready to be used in multiple universities and regions, audit requirements will be reconsidered.)

15.5 Immunity Requirements

The product must only use open source libraries with many users and continuous security updates. As open source libraries are used by millions of people, vulnerabilities are found and patched much earlier.

The product must undergo vulnerability checks before a build is pushed to the users. This will prevent vulnerabilities from inadequate codes from being introduced to user devices.

16 Cultural Requirements

16.1 Cultural Requirements

-

17 Compliance Requirements

17.1 Legal Requirements

The data collected from users will be handled as per the same legal requirements for the university. As this application will be used in university,

it is subject to the same regulations that the university is beholden to. In the future, different functions can be developed to match specific university or state/country requirements, but this is currently not in scope.

17.2 Standards Compliance Requirements

The encryption on data in storage and in transit must be industry standard. This ensures that the application is safe and can be scaled and expanded to other universities or interested parties when needed.

18 Open Issues

- To target iOS devices, a device capable of building iOS apps is required.

19 Off-the-Shelf Solutions

19.1 Ready-Made Products

- **Snapchat:** Snapchat is an existing social media platform that makes use of AR technology through its Lenses feature which provides various filters and effects that users can apply to their content.

- **Instagram:** Instagram is another platform that incorporates AR in the form of filters and effects.

- **TikTok:** TikTok similarly uses AR for visual effects and filters.

- **Facebook:** Many clubs at McMaster use Facebook Groups to coordinate events.

- **Meetup:** Meetup is another platform designed for organizing and finding events and other social gatherings.

- **CampusGroups:** CampusGroups is a platform that focuses specifically on university student groups. It allows universities to create private communities for various events and other student engagement activities.

19.2 Reusable Components

- Event planning, scheduling and searching

- Friends and Groups system

- AR-integrated content (virtual billboards, avatars, ...)

- Asynchrnous communication (text messages, voice messages)

19.3 Products That Can Be Copied

N/A

20 New Problems

20.1 Effects on the Current Environment

This application will not take place of any existing official tools. It intends to improve certain social networking processes students are following and provide a platform for users to connect with each other better. The following are some changes that will impact users.

Expand Networking
Students will be able to expand networking when attending events lectures on this social media platform. Users may lose connection with peers when there is a failure in the system.

Event Registration
Students and alumni will be able to login with their McMaster email and write comments about on campus events, which means there will be a risk of personal identification information (PII) leakage if the data is not stored securely.

Available Room Management
This application can be utilized to get information about lecture time and location which should not be displayed publicly. Therefore insecure data storage may lead to data breaches.

20.2   Effects on the Installed Systems

The application will be completely stand alone and will not be interfacing with any existing systems. As described in the previous section, this application should not affect or replace any existing systems.

20.3   Potential User Problems

Any potential adverse reactions related to using the device in which application is being launched on (mobile device or tablet) would extend to the use of this application. Any adverse reactions of Virtual Reality and Augment Reality, like nausea, dizziness and disorientation would be introduced to the use of the application as well.

20.4   Limitations in the Anticipated Implementation Environment That May Inhibit the New Product

- The database free plan is not able to cope with our projected user growth pattern.

- Low quality internet connection will lead to latency between user inputs and in-game reactions or even failures of loading in-game assets.

- The accuracy of input data totally depends on device sensor. Low accuracy data may cause bad user experience.

20.5   Follow-Up Problems

Any failures or downtime on Unity game engine and its third-party libraries may affect the availability of this application. In-game schedules may fail to load when the event and lecture schedule interfaces are down or the two external systems are under maintenance. There will also be a risk of violating privacy laws in the future since the application is collection personal information and there may be new laws prohibit this kind of information collection.

21 Tasks

21.1 Project Planning

The project schedule will follow the deadline for the deliverables outlined in the SFWRENG 4G06 course outline.

Phase	Task	Deadline
Revision 0	Hazard Analysis	Oct 20, 2023
	Verification and Validation Plan	Nov 3, 2023
	Proof of Concept Demo	Nov 13-24, 2023
	Design Document	Jan 17, 2024
	Demonstration	Feb 5-16, 2024
	Verification and Validation Report	Mar 6, 2024
Revision 1	Final Demonstration	Mar 18-29, 2024
	EXPO Demonstration	April 2024
	Final Documentation	Apr 4, 2024

Table 5: Project Plan

21.2 Planning of the Development Phases

Insert your content here.

22 Migration to the New Product

22.1 Requirements for Migration to the New Product

Insert your content here.

22.2 Data That Has to be Modified or Translated for the New System

Insert your content here.

23 Costs

Insert your content here.

24 User Documentation and Training

24.1 User Documentation Requirements

Insert your content here.

24.2 Training Requirements

Insert your content here.

25 Waiting Room

N/A

26 Ideas for Solution

Insert your content here.

Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Lifelong Learning. Please answer the following questions:

1. What knowledge and skills will the team collectively need to acquire to successfully complete this capstone project? Examples of possible knowledge to acquire include domain specific knowledge from the domain of your application, or software engineering knowledge, mechatronics knowledge or computer science knowledge. Skills may be related to technology, or writing, or presentation, or team management, etc. You should look to identify at least one item for each team member.

2. For each of the knowledge areas and skills identified in the previous question, what are at least two approaches to acquiring the knowledge or mastering the skill? Of the identified approaches, which will each team member pursue, and why did they make this choice?