Software Requirements Specification for Software Eng: Mac AR

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Contents

Table 1: Revision History

Date	Developer(s)	Change
September 26, 2023	Matthew and Sam	Initial changes to the project
September 26, 2023	Matthew	Initial NFR changes
September 28, 2023	All	General format editing and addition of the Use Case Diagram
September 29, 2023	Matthew	Addition of Use cases 1-5 and related functional requirements
September 29, 2023	Kieran	Addition of Use cases 5-10 and related functional requirements
September 29, 2023	Ethan	Added Read-Made Products section to Project Issues
September 30, 2023	Ethan	Completed rest of sections in Project Issues
October 1, 2023	Sam	Filled out sections 1, 6
October 6, 2023	All	Group worked on traceability matrix and finishing rest of SRS
October 27, 2023	Ethan	Updated SRS based on feedback from Team 2 and Team 18
November 3, 2023	Ethan	Updated SRS to include Hazard Analysis requirements
January 4, 2024	Ethan	Updated SRS to include requirement for notifying user to update to latest version of application
March 1, 2024	Ethan	Updated SRS to remove Save/Load/Delete Requirements
March 6, 2024	Sam	Updated PI7 to be more explicit about progress bar
April 1, 2024	All	Added puzzle specific Requirements
April 3, 2024	Kieran	Added statement of template modifications
April 3, 2024	Kieran	Added likely changes section
April 3, 2024	Kieran	Defined ambiguous terms based on peer feedback
April 4, 2024	Kieran	Added fit criterion for CR1, LR1
April 4, 2024	Kieran	Reworked all functional requirement rationale to remove redundancy
April 4, 2024	Kieran	Added/modified requirements for room capacity JG2 and CG3
April 4, 2024	Kieran	Added Phase-In Plan
April 4, 2024	Kieran	Defined missing terminology from NFRs and VnV
April 4, 2024	Kieran	Resolved minor grammar issues and latex quotation marks
April 4, 2024	Kieran	Fixed off-the-shelf solution and current environment sections based on TA feedback
April 4, 2024	Kieran	Removed outdated puzzle dependency formal specification

This document describes the requirements for Mac-AR. The template for the Software Requirements Specification (SRS) is a subset of the Volere template (Robertson and Robertson, 2012) with the following modifications:

- (Added) Section 2.3: Formal Specification
- (Added) Section 2.4: Functional Requirements That Are Likely/Unlikely to Change
- (Added) Section 3.9: Health and Safety Requirements
- (Added) Section 3.10: Non-Functional Requirements That Are Likely/Unlikely to Change
- (Added) Section 4: Traceability matrix
- (Added) Section 5.5: Cutover section replaced with "Migration to the New Product"
- (Added) Section 6: Appendix
- (Merged) Section 1.2: "Stakeholders" and "Users of the Product" sections merged under "Stakeholders" section
- (Modified) Modified overall section nesting and numbering for more logical grouping
- (Modified) Section 5.5: Replaced "Migration to the New Product" with "Requirements Phase-In Plan"

1 Project Drivers

This section will give a general overview of the motivation behind creating Mac-AR, along with what constraints it needs to be created within.

1.1 The Purpose of the Project

In the modern world, it has become increasingly harder to meet new people and form connections with others. This has become especially true in recent years, with the pandemic isolating people even further. Mac-AR aims to solve this by providing a fun, interactive means to cooperate with others and form new connections. As a team, users will be able to work alongside people either co-located or remotely at places they prefer, to solve interesting puzzles and bond with each other.

1.2 The Stakeholders

The following groups and individuals are the reason for the existence of Mac-AR.

1.2.1 The Client

Dr Irene Yuan is the sole client for the project, requesting that the tool be made. She will act as the point of contact during development and ensure that the final result is in line with what was envisioned.

1.2.2 Hands-on Users of the Application

The users are the ones who will be using the tool and building connections with others. The main user base is intended to be young adults, roughly ages 18-30, who enjoy games and are moderately comfortable using technology.

1.2.3 Other Stakeholders

This application will not have a significant impact on those outside of it as the application does not require significant motion from the user or interaction with others not in the game. Warnings will be used in the application to ensure users are aware of their surroundings at all times so as not to disturb others nearby.

1.3 Mandated Constraints

The project will be developed and released within the following constraints.

1.3.1 Solution Constraints

Description: The product shall be built as a mobile application.
Rationale: The supervisor wants the application to be a mobile application, as to ensure the largest freedom to the users for where and how the product will be used.
Fit Criterion: The product shall be written using Unity engine and be accessible on both Android and iOS application stores.

Description: The product shall be able to function on a variety of mobile devices, using both iOS and Android.
Rationale: To provide service to the widest array of users, the most popular phone brands, and by extension their operating systems, need to be supported.
Fit Criterion: The product shall be tested to function on popular mobile devices using iOS and Android, specifically

- Samsung S20 FE 5G
- iPhone SE
- Motorolla G7 Power
- Google Pixel 7
- iPhone Special Edition 2020

1.3.2 Implementation Environment of the Current System

Not applicable as the system is not being built off of an existing solution.

1.3.3 Partner or Collaborative Applications

In the current design of the product, there are no partner or collaborative applications that will work along with the product. Therefore, there are no partner or collaborative constraints.

1.3.4 Off-the-Shelf Software

There is no current solution off of which the system is being built or constraints regarding any such software.

1.3.5 Anticipated Workplace Environment

The anticipated workplace environment will be intentionally broad. The product can be used from anywhere the user has access to a mobile device and an internet connection to run the application, with no limits on being indoors.

1.3.6 Schedule Constraints

The general document and development milestone constraints are as follows:

Table 2: Schedule Constraints

Date	**Deliverable**
Sept 25, 2023	Problem Statement
Sept 25, 2023	Development Plan
Oct 5, 2023	Requirements Document
Oct 20, 2023	Hazard Analysis
Nov 3, 2023	Verification and Validation Plan
Nov 13-24, 2023	Proof of Concept Demo
Jan 17, 2024	Design Document
Feb 5-16, 2024	Revision 0 Demo
Mar 6, 2024	Verification and Validation Report
Mar 18-29, 2024	Final Demo (Rev 1)
Apr 4, 2024	Final Documentation

As a general constraint applied on top of all of these, all work should be done a few days in advance to allow for time to review.

1.3.7 Budget Constraints

The project has no monetary budget. If there are any necessary purchases for development, the cost shall be paid by the project members and reimbursed by the supervisor. Furthermore, these purchases may not exceed $750.

1.3.8 Enterprise Constraints

The project currently has no enterprise constraints.

1.4 Naming Conventions and Terminology

Symbol	description
Asset	Any game object that appears in the game
A	Assumption
AR	Augmented Reality
CI/CD	Continuous Integration/Continuous Development
CR	Cultural Requirements
DD	Data Definition
ESRB	Entertainment Software Ratings Guide
GD	General Definition
GPS	Global Positioning System
GS	Goal Statement
HA	Hazard Analysis
HS	Health and Safety Requirements
IM	Instance Model
iOS	iPhone Operating System
LC	Likely Change
LF	Look and Feel Requirements
LR	Legal Requirements
MG	Module Guide
MIS	Module Interface Specification
MS	Maintainability and Support Requirements
NUnit	C# unit testing module
OE	Operational and Environmental Requirements
PoC	Proof of Concept
PR	Performance Requirements
PS	Physical System Description
Puzzle State	The current variable values and UI appearance of the puzzle
R	Requirement
Rev	Revision
RS	Required Skill
Scene	The area of the game visible on the device
SR	Security Requirements
SRS	Software Requirements Specification

Symbol	description
Software Eng	Software Engineering
TA	Teaching Assistant
TM	Theoretical Model
UH	Usability and Humanity Requirements
UI	User Interface
Unity	Game Development Engine
Vivox	Text and Voice Communication module for Unity
VR	Virtual Reality
VnV	Verification and Validation
WCAG	Web Content Accessibility Guidelines
XR	Extended Reality

1.5 Relevant Facts and Assumptions

The product will be developed under the following assumptions.

1.5.1 Device Assumptions

A1 Devices will only have a maximum of one instance of the app running at any given time.

A2 The device that the app is running on will have a functional camera.

A3 The device that the app is running on will have a functional gyroscope, or equivalent technology to measure device tilt.

A4 The device that the app is running on will have a functional GPS, or equivalent technology to measure device location.

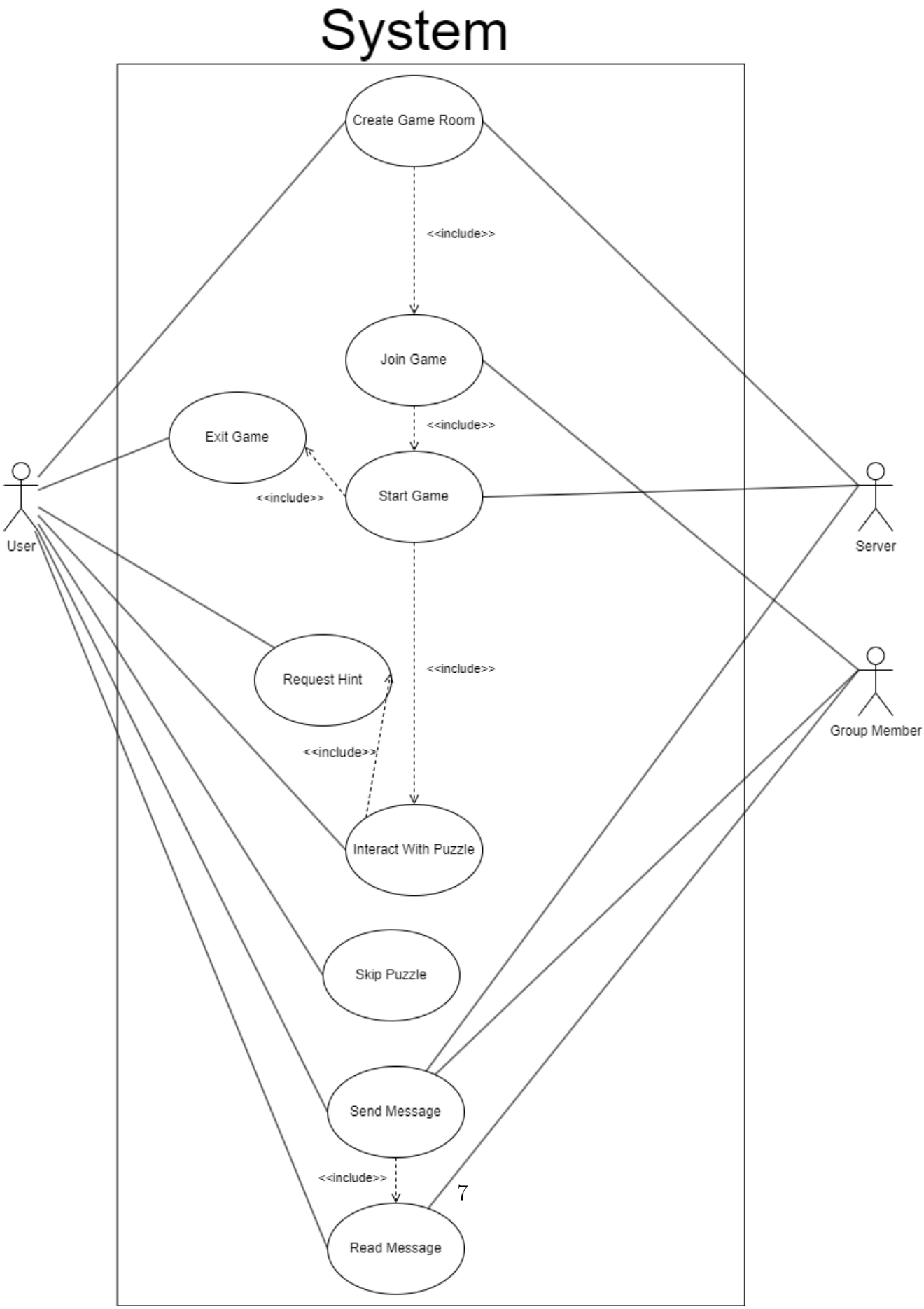
2 Functional Requirements

The following section will go over the necessary functional requirement information for the project, including use cases.

2.1 The Scope of the Work and the Product

2.1.1 Context of the Work

The context diagram depicted below illustrates the interactions of the system with adjacent external systems and services.


System
Create Game Room
<<include>>
Join Game
<<include>>
Exit Game
<<include>>
Start Game
User
Server
Request Hint
<<include>>
<<include>>
Group Member
Interact With Puzzle
Skip Puzzle
Send Message
<<include>>
Read Message

2.1.2 Individual Product Use Cases

Use Case #1: User creates a game room
Trigger: The user selects the create game room button
Pre-condition: N/A
Outcome:

1. The system creates a room for users to join, and automatically makes the user join the room
2. The user can choose the room settings
3. The server sends the data of the game room to all the users, to show that the room is available to join, and the capacity of the room, and the current users that have joined the room

Use Case #2: User Joins Game
Trigger: The user selects a room to join that has available capacity
Pre-condition: Another user has created a game room
Outcome:

1. The system links the user to the game room, and decreases the available capacity in the room
2. The server retrieves the data from the game room and updates the game room for all the users with the newly joined user's name, and decreases the visible room capacity

Use Case #3: User edits the game room settings
Trigger: The user of the game room clicks the edit game settings button
Pre-condition: The user created the game room
Outcome:

1. The system opens the game room settings page
2. The settings are displayed for the user
3. The user chooses the settings they want to change
4. The system updates the game room settings
5. The server informs the other group members of the settings changes
6. The user closes the settings page

Use Case #4: User exits the game room
Trigger: The user clicks the exit game room button
Pre-condition: The user is currently in a game room
Outcome:

1. The user is removed from the game room
2. The system updates the information of the game room
3. The server sends the updated information to each group member in the game room
4. The user is brought back to the main menu

Use Case #5: User starts the game
Trigger: The users in a game room click the start game button
Pre-condition: The game room has all group members present
Outcome:

1. The server launches the game and synchronizes the user and group member data.
2. The user performs a synchronization step to map the room and place the puzzles
3. The system shows the user and group members the first puzzles
4. The user and group members are each given a unique view on the puzzles they have available to them

Use Case #6: User interacts with a puzzle
Trigger: The user selects a puzzle to attempt
Pre-condition: The user has started a puzzle
Outcome:

1. The system displays an enlarged and interactable version of the puzzle
2. The user performs an action on the puzzle
3. The system registers the action, performs any necessary puzzle state changes and displays the new puzzle state to the user

Use Case #7: User requests a hint
Trigger: The user presses the request hint button
Pre-condition: The user has started a puzzle
Outcome:

1. The system displays the predetermined hint for the associated puzzle
2. The user reads the hint and presses the button to close the hint
3. The system closes the hint display

Use Case #8: User skips a puzzle
Trigger: The user hits the skip button
Pre-condition: The user is interacting with a puzzle
Outcome:

1. The system saves the state of the puzzle and closes the puzzle display, returning to the main scene

Use Case #9: User sends a message
Trigger: The user presses a communication button
Pre-condition: More than one user are in a game room
Outcome:

1. The system queries the server to determine the group members in the room
2. The system displays the other group members in the room to the user
3. The system displays the interface for the user to create the message
4. The user creates the message and hits the send button
5. The system uses the server to send the message group members devices and to create a message notification on those devices. It then notifies the sender that the message has been sent

Use Case #10: User reads a message
Trigger: The user clicks on a received message notification
Pre-condition: The user has received a message
Outcome:

1. The system removes the message notification and displays the message to the user
2. The user reads the message, then closes the message display window
3. The system returns the user to the main game scene

2.2 Functional Requirements

2.2.1 Create Game Room

CG1. The system shall allow the user to create a game room
Rationale: The user must be able to group together with other users, creating the game room will allow the users to organize the group
Related Use Cases: Use Case 1
Related Requirements: LF1, UH1, UH2, UH3, UH4, PR1, PR2, OE1, SR1, SR2, CR2

CG2. The system shall allow the user to enter a name for the game room
Rationale: The users must be able to uniquely identify the game rooms to allow the other users to find the room they want to join in case they have a group they wanted to solve the puzzles with
Related Use Cases: Use Case 1
Related Requirements: LF1, LF2, UH1, UH3, OE1, SR1, SR2, CR1, CR2

CG3. The system shall allow the user to set the size of the game room to a value between 1 and 10
Rationale: The user may want to play with a smaller or larger group. The values of 1 and 10 are the minimum and maximum expected number of players
Related Use Cases: Use Case 1
Related Requirements: LF1, LF2, UH1, UH3, OE1, SR1, SR2, CR2

CG4. The system shall allow the user to put a password on the game room
Rationale: The user should be able to allow or disallow any other users from joining except the ones they want in the case they are playing with friends
Related Use Cases: Use Case 1
Related Requirements: LF1, LF2, UH1, UH3, OE1, SR1, SR2, CR2

CG5. The system shall redirect the user to a new screen when in a game room displaying the users in the room
Rationale: The user can use this screen to wait for other users to join the room and see which users join
Related Use Cases: Use Case 1
Related Requirements: LF1, LF2, PR1, PR2, UH1, UH3, OE1, SR1, SR2, CR2

2.2.2 Join Game Room

JG1. The system shall allow the user to join an existing game room with available capacity
Rationale: The user must be able to group up with other users
Related Use Cases: Use Case 2
Related Requirements: LF1, LF2, PR1, PR2, UH1, UH2, UH3, UH4, OE1, SR1, SR2, CR1, CR2

JG2. The system shall not allow the user to join an existing game room without available capacity
Related Use Cases: Use Case 2
Related Requirements: LF1, LF2, PR1, PR2, UH1, UH2, UH3, UH4, OE1, SR1, SR2, CR2

JG3. The system shall allow the user to enter a password for the room if another user set a password for the room
Related Use Cases: Use Case 2
Related Requirements: LF1, LF2, UH1, UH3, OE1, SR1, SR2, CR2

JG4. When a user joins the game room the system shall update the game room information to add another member, and decrease the available capacity
Rationale: This provides users with an accurate representation of how much availability rooms have
Related Use Cases: Use Case 2

Related Requirements: LF1, LF2, UH1, UH2, UH3, PR1, PR2, OE1, SR1, SR2, CR2

JG5. The system shall redirect the user to a new screen upon successfully connecting to a room where they can see the other users in the room
Rationale: This provides feedback to the user that they've successfully joined the room while they wait for the host to start the game
Related Use Cases: Use Case 2
Related Requirements: LF1, LF2, UH1, UH2, UH3, PR1, PR2, OE1, SR1, SR2, CR2

2.2.3 Edit Room Settings

RS1. The system shall allow the user that created the game room to edit the settings of the game room
Rationale: Allows a user to fix mistakes in the initial settings or accommodate unanticipated changes
Related Use Cases: Use Case 3
Related Requirements: LF1, UH1, UH3, OE1, SR1, SR2, CR1, CR2

RS2. The system shall populate all the changeable settings on the user's screen
Rationale: The user must know what they can change
Related Use Cases: Use Case 3
Related Requirements: LF1, LF2 UH1, UH3, OE1, SR1, SR2, CR2

RS3. The system shall allow the user to change the password of the room
Rationale: Allows the user to ensure room security if the password is accidentally shared with an unintended source
Related Use Cases: Use Case 3
Related Requirements: LF1, UH1, UH3, OE1, SR1, SR2, CR2

RS4. The system shall display the updated settings to the game members in the game room
Rationale: Other users in the game room should know what changed in case it will affect them
Related Use Cases: Use Case 3
Related Requirements: LF1, LF2, UH1, UH2, UH3, OE1, PR1, PR2, SR1, SR2, CR1, CR2

2.2.4 Exit Room

ER1. The system shall allow the user to leave the existing game room
Rationale: The user might decide they no longer wish to play the game
Related Use Cases: Use Case 4
Related Requirements: LF1, LF2, UH1, UH3, OE1, PR1, SR1, SR2, CR2

ER2. When a group member leaves the room the system shall update the game room and display the one less user
Rationale: This provides users outside the room with an accurate representation of how much availability the room has
Related Use Cases: Use Case 4
Related Requirements: LF1, LF2, UH1, OE1, PR1, SR1, SR2, CR2

ER3. When a group member leaves the room the server shall update the screens of all group members remaining in the room to show the new amount of users and the updated capacity
Rationale: This provides users in the room with an accurate representation of who is in the room
Related Use Cases: Use Case 4
Related Requirements: LF1, LF2, UH1, OE1, PR1, SR1, SR2, CR2

2.2.5 Start Game

ST1. The system shall allow the user to start the game
Related Use Cases: Use Case 5
Related Requirements: LF1, UH1, UH3, OE1, PR1, PR2, SR1, SR2, CR2

ST2. The system shall load all the assets used to play the game
Rationale: Loading all the assets at the start of the game will stop pauses during gameplay
Related Use Cases: Use Case 5
Related Requirements: UH1, OE1, PR1, SR1, SR2

ST3. The system shall determine an order of the puzzles, and which group members can see which parts of the puzzles
Rationale: This allows variability in puzzle order and user roles in each puzzle

ST4. The system shall reveal the available puzzles to the group members and commence the game
Related Use Cases: Use Case 5
Related Requirements: UH1, OE1, SR1, SR2

2.2.6 Puzzle Interaction

PI1. The system shall allow users to perform all necessary actions on the puzzle to complete the puzzle
Rationale: The user must be able to complete the puzzles in order to progress in the game
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1, PR1, PR2, SR1, SR2, CR2

PI2. The system shall display the new puzzle state after a user performs an action on a puzzle
Rationale: The user must be able to see the results of their actions in order to decide how to proceed with the puzzle
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, OE1, PR1, PR2, SR1, SR2, CR2

PI3. The system shall update the puzzle state of group members cooperating on an updated puzzle
Rationale: The results of the actions of one user affect the decisions necessary for other group members
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1, PR1, SR1, SR2, CR2

PI4. The system shall notify the user when they have completed a puzzle
Rationale: Informs users that they can move on from the puzzle. A notification at the end of a puzzle can also make completing it more satisfying for the user
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1, PR1 **Related Use Cases:** Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, OE1, PR1, SR1, SR2, CR2

2.2.7 Hint Request

HR1. The system shall have two hints for each puzzle
Rationale: If a user gets stuck on a puzzle they should have an alternative to giving up on the puzzle
Related Use Cases: Use Case 7
Related Requirements: LF1, LF2, UH1, UH3, PR1, PR2, OE1

HR2. The system shall have a means of requesting a hint for the puzzle to be displayed
Related Use Cases: Use Case 7
Related Requirements: LF1, LF2, UH1, UH3, PR1, PR2, OE1

HR3. The system shall allow the user to close the hint display
Rationale: Keeping the hint on the screen may obstruct other functions
Related Use Cases: Use Case 7
Related Requirements: LF1, UH1, UH3, PR1, PR2, OE1

2.2.8 Skip Puzzle

SP1. The system shall allow the user to skip a puzzle, progressing to the next puzzle
Rationale: As this game is being created primarily for the study, the skip option may be needed for time purposes or if a puzzle cannot be solved

Related Use Cases: Use Case 8
Related Requirements: LF1, UH1, UH3, PR1, PR2, OE1

SP2. The system shall notify any group members cooperating on the skipped puzzle that it has been skipped
Rationale: A group members work on a puzzle will typically depend on another group members work on the puzzle. They must be notified the puzzle has been skipped so they are not waiting on an action from the group member
Related Use Cases: Use Case 8
Related Requirements: LF1, UH1, UH3, PR1, PR2, OE1

2.2.9 Send Text Message

SM1. The system shall contain an interface that allows the user to compose text messages
Rationale: The user must be able to create their own custom messages to allow for optimal communication in puzzles and to create the most realistic social experience
Related Use Cases: Use Case 9
Related Requirements: LF1, LF2, UH1, UH3, PR1, PR2, OE1

SM2. The system shall allow the user to send a message to the users in the game room
Rationale: The primary goal of the game is to allow users to have social interaction from a remote setting. All users in the game must be able to interact with one another to complete this goal
Related Use Cases: Use Case 9
Related Requirements: LF1, LF2, UH1, UH2, UH3, UH4, PR1, PR2, OE1

SM3. The system shall allow the user to cancel a message before sending it
Rationale: If a user decides they do not want to send a message they must be able to return to the game without having to send something
Related Use Cases: Use Case 9
Related Requirements: LF1, LF2, UH1, UH3, PR1, PR2, OE1

SM4. The system shall notify the user once the message has been sent
Rationale: It is important that the user receive feedback that the message has been sent so there is no uncertainty or confusion for the user
Related Use Cases: Use Case 9
Related Requirements: LF1, UH1, UH2, UH3, UH4, PR1, PR2, OE1

2.2.10 Read Message

RM1. The system shall notify the user when a new text message is received
Rationale: Communication is core to the game. If a user doesn't know when they receive a message good communication will not be maintained
Related Use Cases: Use Case 10
Related Requirements: LF1, UH1, UH2, UH3, UH4, PR1, PR2, OE1

RM2. The system shall allow the user to view text messages
Rationale: Users must be able to see what other users are trying to communicate to them for social purposes and to complete puzzles
Related Use Cases: Use Case 10
Related Requirements: LF1, LF2, UH1, UH2, UH3, UH4, PR1, PR2, OE1

RM3. The system shall allow users to close the message display
Rationale: The message display can block other functions if left open
Related Use Cases: Use Case 10
Related Requirements: LF1, UH1, UH3, PR1, PR2, OE1

2.2.11 Voice Communication

VM1. The system shall allow users to communicate with one another through a voice chat
Rationale: To allow more fluid and more complex communication users should be able to communicate through a voice chat in addition to the text messaging.
Related Use Cases: Use Case 9
Related Requirements: UH1, UH2, UH3, UH4, PR1, PR2, OE1

VM2. The system shall allow users to mute themselves in the voice chat at any time while they are in the game room
Rationale: Users should not be forced to utilise the voice communication system as they may be in a location with unwanted background noise or where they cannot speak freely
Related Use Cases: Use Case 9
Related Requirements: LF1, UH1, UH3, PR1, PR2, OE1

2.2.12 Simon Says Puzzle

SS1. The system shall display the coloured buttons to the host user at the start of the game
Rationale: Users must be able to see puzzle assets that they need to interact with
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

SS2. The system shall display the colour cube to all users other than the host at the start of the game
Rationale: Users must be able to see puzzle assets that they need to interact with
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

SS3. The system shall display the current Simon Says level to all users while the puzzle is active
Rationale: The level indicates the current number of correct sequences the group has inputted, and shows progression through the puzzle

Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, OE1

SS4. The system shall display a sequence of colours on the colour cube when the puzzle is active
Rationale: The sequence of colours must be shown in order so that the users can communicate and the individual with the coloured buttons can enter the correct sequence
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

SS5. The system shall increase the Simon Says level once the user inputs colour sequence using the coloured buttons
Rationale: Once the user enters the correct sequence, a new, longer sequence is generated which must be completed in order to reach the end of the puzzle
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

SS6. The system shall put the Simon Says level to one if the user inputs the incorrect colour sequence using the coloured buttons
Rationale: Once the user enters the correct sequence, a new, longer sequence is generated which must be completed in order to reach the end of the puzzle
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

SS7. The system shall display the puzzle as completed once level 3 is completed
Rationale: The puzzle should be able to be completed in order for users to be able to progress through the escape room. Additionally, level 3 is the highest level since the puzzle is supposed to take several minutes to solve and the time it takes to reach this level is in accordance to that
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

2.2.13 Maze Puzzle

MP1. The system shall randomly create a maze with a starting location, an end goal, and a ball that falls with gravity.
Rationale: The puzzle should be highly re-playable, providing a different experience for users each time, and the maze needs an end goal to reach
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

MP2. The system shall choose a user to be in control of rotating the maze
Rationale: The goal of the puzzle is to have one person rotate the maze, and the rest of the users to guide the person in charge of rotating

Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

MP3. The system shall make the inside of the maze only visible to users that can't rotate the maze
Rationale: If the user in charge of rotating could see inside the maze, it would defeat the whole purpose
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

MP4. When the user in charge of rotating rotates their phone, the maze should rotate proportionally
Rationale: The user should be able to rotate the maze easily and have a reasonable amount of positive feedback
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, PR1, OE1

MP5. The system shall complete the puzzle when the ball reaches the end goal
Rationale: The users should have a way to finish the maze
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, PR1, OE1

2.2.14 Isometric Puzzle

IP1. The system shall randomly assign letter and number combinations to every user in the game, based on a word the system chooses
Rationale: Each user needs to have their own respective puzzle elements they can interact with, and there needs to be an end goal word.
Related Use Cases: Use Case 6
Related Requirements: UH1, OE1

IP2. The system shall generate arrangements of blocks for each user that resemble letters and numbers based on the angle the user views them, and based on the letter and number combos each user was assigned
Rationale: The goal of the puzzle is to complete a word based on letters in positions, the position given by the number they see, and the letter given by the letter they see
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

IP3. The system shall have left and right buttons to switch between letter and number combinations
Rationale: For groups of users with a size less than the amount of letters in the word, they need a way to switch between the available letters and numbers they have
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

IP4. The system shall have an input field for users to enter their final guess into
Rationale: The users need to way to guess what the word is to complete the puzzle
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

IP5. When the word entered into the input field is the same as the word the system drew letter and number combinations from, the puzzle completes
Rationale: There needs to be a puzzle completion condition
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

2.2.15 Combination Puzzle

CP1. The system shall randomly select a set of instructions and associated four-digit combination from the available set of instruction-combination pairings and distribute the instructions as evenly as possible between the users displaying said instructions
Rationale: The puzzle should be highly re-playable, providing a different experience for users each time
Related Use Cases: Use Case 6
Related Requirements: UH1, OE1

CP2. The combination associated with each instruction set shall be the only possible four-digit combination given the associated instructions
Rationale: There must be exactly one solution for each version of the puzzle for users to be able to solve it using the instructions.
Related Use Cases: Use Case 6
Related Requirements: UH1, OE1

CP3. The system shall update the current combination display field for all users in the room with the correct digit when a user presses a button corresponding to the correct digit of the combination
Rationale: When a user enters a correct digit of the combination, all users should see this reflected on the keypad interface so that they know that number was correct and can progress in the puzzle
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

CP4. The system shall indicate to all users when a user has pressed a keypad button associated with an incorrect digit of the combination
Rationale: Users must be able to tell when they've entered an incorrect digit so that they do not continue trying this digit
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

CP5. The system shall reset the combination display field for all users when a user has pressed a keypad button associated with an incorrect digit of the combination
Rationale: Resetting the combination entry on each incorrect input encourages more communication as there is a greater penalty for incorrect inputs. It also helps prevent spam guessing all possible combinations
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

CP6. The system shall complete the puzzle once all four digits of the combination have been entered correctly, displaying a "Correct" message on the keypad interface
Rationale: When the puzzle has been successfully completed users must be able to move on to the next puzzle. The puzzle should have a visual indicator of this so users know to start looking for the next task.
Related Use Cases: Use Case 6
Related Requirements: LF1, LF2, UH1, UH3, PR1, OE1

2.2.16 Wires Puzzle

WP1. The puzzle shall display a box of four coloured wires to the user designated as the active user
Rationale: A single user must be able to see the puzzle asset that they can interact with
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

WP2. A set of four pairs of coloured dots shall be displayed for all users not designated as the active user
Rationale: The remaining users must be able to see the puzzle asset containing the solution to the puzzle
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

WP3. The four coloured wires must be able to be manipulated by the user such that their tip follows the movement of the users finger while they are dragged across the screen
Rationale: To complete the puzzle, the wires must be able to be dragged into their designated positions
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, PR1, OE1

WP4. When a wire tip is dragged by a user, the position of the wire must remain in place when the wire is released
Rationale: When the user stops dragging, the wires must not reset to their original positions to allow the puzzle to be completed
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, PR1, OE1

WP5. The four pairs of coloured dots shall match up with the proper solution to the wires puzzle. Each pair of dots shall indicate a correct connection, with the colour of the node as the dot on top and the colour of the wire as the dot on the bottom
Rationale: The active part of the puzzle must align with the hint given to the other users for the puzzle to be able to be completed
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

WP6. When the wires are connected to the nodes in an improper sequence, no change occurs
Rationale: The puzzle must only be able to be completed with a single correct sequence
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

WP7. When the wires are connected to the nodes in the correct sequence, the puzzle completes
Rationale: The correct sequence must complete the puzzle
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, PR1, OE1

WP8. When the puzzle is spawned and inactive, its lights will be off
Rationale: The initial state of the puzzle will have its lights off to indicate to the user not to interact with it yet
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, OE1

WP9. When the puzzle is set to become active, its lights will turn red
Rationale: The lights will turn red to indicate that the puzzle is active but not yet completed
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, PR1, OE1

WP10. When the puzzle is completed, its lights will turn green
Rationale: The lights will turn green to indicate to the user that the puzzle has been completed
Related Use Cases: Use Case 6
Related Requirements: LF1, UH1, UH3, PR1, OE1

2.3 Formal Specification

$$(\forall r \in rooms | (\sum_{user \in r} 1) \leq r.roomCapacity)$$

The users that exist in a room shall be within the capacity of the room

Likely	Unlikely
CG4, JG3, RS3, HR1, HR2, HR3, SP1, SP2, SS1, SS2, SS3, SS4, SS5, SS6, SS7, MP1, MP2, MP3, MP4, MP5, IP1, IP2, IP3, IP4, IP5, CP1, CP2, CP3, CP4, CP5, CP6, WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8, WP9, WP10	CG1, CG2, CG3, CG5, JG1, JG2, JG4, JG5, RS1, RS2, RS4, ST1, ST2, ST3, ST4, PI1, PI2, PI3, PI4, SM1, SM2, SM3, SM4, RM1, RM2, RM3, VM1, VM2, Formal Specification

Table 3: Non-Functional Likely/Unlikely to Change Table

2.4 Functional Requirements That Are Likely/Unlikely to Change

- CG1, CG2, CG3, CG5 are all unlikely to change as they are basic properties/needs of a game room that users are able to join
- JG1, JG2, JG4, JG5, are all unlikely to change as capacity updates and scene changes when joining a room will always be necessary features
- RS1, RS2, RS3 are all unlikely to change as the capability to edit room settings after creating a room adds convenience to the game that will be useful when performing the study and for casual players of the game
- CG4, JG3, RS3 are fairly likely to change as it is not necessary that a game room have a password. It may be decided that this requirement is not needed
- ST1, ST2, ST3, ST4 are all unlikely to change as the game start procedure is core to the identity of the game as a multiplayer augmented reality communication-based game
- PI1, PI2, PI3, PI4 are all unlikely to change as it is unlikely the game will be modified such that users do not need to be able to interact with their puzzles and see the result of these interactions
- HR1, HR2, HR3, SP1, SP2 are all likely to change as hints and skips have been primarily implemented to facilitate the study. If the game changes to become more time-based and competitive these features may change or be removed
- SM1, SM2, SM3, SM4, RM1, RM2, RM3, VM1, VM2 are all unlikely to change as they are the core properties of text and voice communication which are fundamental to the game which is based on communication. Requirements may however be added to these sections if these features are expanded upon in the future
- All individual puzzle requirements (SS, MP, IP, CP, WP) are likely to changes as the puzzles in the game may be swapped out or heavily modified in the future. The

individual puzzles are the most variable part of this game and could easily be changed without altering the identity and purpose of the game

- The formal specification is unlikely to change as a room should never exceed its capacity

3 Non-functional Requirements

The following section will describe the non-functional requirements of the application.

3.1 Look and Feel Requirements

LF1. The system shall adjust and scale to fit the physical screen size
Fit criterion: The display should cover the entire screen and none of it should be cutoff

LF2. The system shall have fonts and colours that will allow users to easily read the text
Fit criterion: The system shall abide by the Web Content Accessibility Guidelines (WCAG) 2.1 AA standard (Cooper, 2023) for fonts and colours

3.2 Usability and Humanity Requirements

UH1. The system shall be accessible by any supported mobile devices using up to date software
Fit criterion: The system should allow the application to be launched displaying the initial menu screen on the devices listed in solution constraint 1.3.1 with an operating system satisfying OE1

UH2. The system shall notify the user if there is no network, or they get disconnected
Fit criterion: The system should produce a notification when network connection is lost

UH3. The system shall reasonably be able to be navigated
Fit criterion: The system shall abide by the WCAG 2.1 AA standard (Cooper, 2023) for accessibility

UH4. The system shall prompt the user to re-enter an area with internet connection when it detects there is no network
Fit criterion: The system should produce a notification when network connection is lost

UH5. The system shall prompt the user if their current environment is unsuitable to use the application
Fit criterion: The system will produce a pop up notification during startup to let user know of issues with their environment, as well as if after startup the user environment becomes unsuitable. This may include lighting or distance to spawned puzzles

UH6. The system shall allow users to reconnect to their game session if they become disconnected
Fit criterion: The system will prompt the user to reconnect to their game session through a reconnect button, which upon pressing will reconnect to the user's previous session

UH7. The system shall inform users who are using an old version of the application to check for updates and use the latest version
Fit criterion: The system will produce a notification to let the user know to update their application to the latest version, in order to play online

3.3 Performance Requirements

PR1. The system shall respond to user interaction within 5 seconds
Fit criterion: The system shall respond within a reasonable amount of time to a user's request

PR2. The system shall be available for users at any time or display the reasoning for the system outage
Fit criterion: The system will be accessible 24 hours a day unless the server is undergoing maintenance or experiencing an outage. If there is maintenance or an outage an error message is displayed stating the respective issue

3.4 Operational and Environmental Requirements

OE1. The system shall be available on Android 11 or above and iOS 16 or above
Fit criterion: The system shall be able to be downloaded from the Google Play Store and Apple Store on devices that have Android 11 or iOS 16 (or later) operating systems

3.5 Maintainability and Support Requirements

MS1. The system shall be well documented and kept up to date, and have updated design documents
Fit criterion: All changes in the system design are to be reflected in the documents in the GitHub

MS2. The source code shall be well commented for future developers
Fit criterion: The system will have author names and dates present in developer code, as well as descriptions of what every system module and function do. An external developer must be able to understand the function of any part of the code from the comments.

3.6 Security Requirements

SR1. The system shall keep user data private
Fit criterion: Game room passwords or IP addresses should not be displayed and should only be accessible to the internal system functions. No external data queries to the database or the system should be able to retrieve this information.

SR2. The users will only be allowed to see limited data. Unnecessary data will not be displayed to the user as providing the user with data related to implementation or other users could leave other users or the system vulnerable to malicious attacks
Fit criterion: The system shall only show users any data required in order to play the game

3.7 Cultural Requirements

CR1 The system shall not use any offensive images, text, or sound that could offend any religious or cultural groups *Fit criterion: The game shall comply with the Entertainment Software Rating Board (ESRB) "E for Everyone" rating standards (Entertainment Software Rating Board, 2024)*

CR2 The system shall use Canadian English

3.8 Legal Requirements

LR1 The system shall not infringe on the rights of any person(s), and shall not use any assets that infringe on copyright claims. When using open source resources, the developers shall give appropriate credit *Fit criterion: All assets used are open source with credit provided to authors or free access. No copyrighted assets are used*

3.9 Health and Safety Requirements

HS1 The system shall give a warning to the user to be aware of their surroundings while using the system, and to not bump into any objects or obstacles in their path

3.10 Non-Functional Requirements That Are Likely/Unlikely to Change

- LF1 and LF2 are unlikely to change as they are basic visual requirements to make the app usable
- UH1, UH2, UH3, UH4, UH5, UH6, UH7 are unlikely to change as they are navigation, environment and network based requirements that are required for reasonable usability of the game

Likely	Unlikely
PR1, OE1, CR2	LF1, LF2, UH1, UH2, UH3, UH4, UH5, UH6, UH7, PR2, MS1, MS2, SR1, SR2, CR1, LR1, HS1

Table 4: Non-Functional Likely/Unlikely to Change Table

- PR1 is likely to change. As game systems improve the maximum response time should be able to be reduced significantly
- PR2 is unlikely to change as users should always be notified when the game is not available
- OE1 is likely to change as newer devices come out and the system evolves to meet those specifications
- MS1 and MS2 are unlikely to change as documentation should always remain up to date to facilitate maintainability
- SR1 and SR2 are unlikely to change as user data confidentiality and protection should always remain in place
- CR1 is unlikely to change as the game should never contain offensive content
- CR2 is likely to change as the game may be expanded to include more languages
- LR1 is unlikely to change as the game must remain legally viable
- HS1 is unlikely to change as this warning is needed to protect users

4 Traceability Matrix

	LF1	LF2	UH1	UH2	UH3	UH4	UH5	UH6	UH7	PR1	PR2	OE1	MS1	MS2	SR1	SR2	CR1	CR2	LR1	HS1
CG1	X		X	X	X	X				X	X	X			X	X		X		
CG2	X	X	X		X							X			X	X	X	X		
CG3	X	X	X		X							X			X	X		X		
CG4	X	X	X		X							X			X	X		X		
CG5	X	X	X		X					X	X	X			X	X		X		
JG1	X	X	X	X	X	X				X	X	X			X	X	X	X		
JG2	X	X	X	X	X	X				X	X	X			X	X		X		
JG3	X	X	X		X							X			X	X		X		
JG4	X	X	X	X	X					X	X	X			X	X		X		
JG5	X	X	X	X	X					X	X	X			X	X		X		
RS1	X		X		x							X			X	X		X		
RS2	X	X	X		X							X			X	X		X		
RS3	X		X		X							X			X	X		X		
RS4	X	X	X	X	X					X	X	X			X	X	X	X		
ER1	X	X	X		X					X		X			X	X		X		
ER2	X	X	X							X		X			X	X		X		
ER3	X	X	X							X		X			X	X		X		
ST1	X		X		X					X	X	X			X	X		X		
ST2			X							X		X			X	X				
ST3	X		X		X					X		X								
ST4			X									X			X	X				
PI1	X		X		X					X	X	X			X	X		X		
PI2	X	X	X		X					X	X	X			X	X		X		
PI3	X		X		X					X		X			X	X		X		
PI4	X	X	X		X					X		X			X	X		X		
HR1	X	X	X		X					X	X	X								
HR2	X	X	X		X					X	X	X								
HR3	X		X		X					X	X	X								
SP1	X		X		X					X	X	X								
SP2	X		X		X					X	X	X								
SM1	X	X	X		X					X	X	X								
SM2	X	X	X	X	X	X				X	X	X								
SM3	X	X	X		X					X	X	X								
SM4	X		X	X	X	X				X	X	X								
RM1	X		X	X	X	X				X	X	X								
RM2	X	X	X	X	X	X				X	X	X								
RM3	X		X		X					X	X	X								

Table 5: Traceability Matrix

	LF1	LF2	UH1	UH2	UH3	UH4	UH5	UH6	UH7	PR1	PR2	OE1	MS1	MS2	SR1	SR2	CR1	CR2	LR1	HS1
VM1			X	X	X	X				X	X	X								
VM2	X		X		X							X								
SS1	X		X		X							X								
SS2	X	X	X		X							X								
SS3	X		X		X							X								
SS4	X	X	X		X							X								
SS5	X	X	X		X					X		X								
SS6	X	X	X		X					X		X								
SS7	X	X	X		X					X		X								
MP1	X		X		X							X								
MP2	X		X		X							X								
MP3	X		X		X							X								
MP4	X		X		X					X		X								
MP5	X		X		X					X		X								
IP1			X									X								
IP2	X		X		X							X								
IP3	X		X		X							X								
IP4	X	X	X		X					X		X								
IP5	X	X	X		X					X		X								
CP1			X									X								
CP2	X	X	X		X					X		X								
CP3	X	X	X		X					X		X								
CP4	X	X	X		X					X		X								
CP5	X	X	X		X					X		X								
CP6	X	X	X		X					X		X								
WP1	X		X		X							X								
WP2	X		X		X							X								
WP3	X		X		X					X		X								
WP4	X		X		X					X		X								
WP5	X		X		X							X								
WP7	X		X		X							X								
WP7	X		X		X					X		X								
WP8	X		X		X							X								
WP9	X		X		X					X		X								
WP10	X		X		X					X		X								

Table 6: Traceability Matrix

5 Project Issues

The following section will go over the current issues for the project. It will describe open issues, current off-the-shelf solutions, new problems, and tasks that need to be worked on.

5.1 Open Issues

There are no open issues for this project.

5.2 Off-the-Shelf Solutions

The following section will go over existing off-the-shelf solutions and reusable components from these solutions.

5.2.1 Ready-Made Products

There are several already made products that have similar aspects to the project however they are missing some key aspects. Examples include ARctic Escape and We Were Here. Similarly to this project, ARctic Escape is an AR game that encourages social interaction. Users must work together to solve puzzles and complete the game (Knoll et al., 2023) . The main difference between this project and ARctic Escape is that in ARctic Escape, users must be in the same area/room to play the game, however, Mac-AR is based around users being able to interact and play the game remotely. Continuing on, We Were Here is a two player game in which users must work together to solve difficult puzzles. The game can be played remotely between the two players and there is an in-game communication system that allows the users to talk to each other. We Were Here, however, does not have any AR component to it, which is one of the main aspects of this project.

5.2.2 Reusable Components

Plenty of libraries and other frameworks that already exist can be used in the project. AR Foundation is one such framework that can be used through Unity. It supports features such as device tracking and 2D image tracking which can be used for tracking the movement of users phones while playing the game. Additionally, there are the Zed-Rig plugins that Unity supports. These can help provide functionality for AR object placement as well as spatial mapping. Continuing on, ARctic Escape which was mentioned in the Ready-Made Products, was able to have spatial mapping through a Snapchat Lens. This allowed for users to record their surroundings and have the room they were in mapped and able to be used in the AR environment.

5.2.3 Products That Can Be Copied

Currently, the only known product that is similar to this project and can be copied without copyright issues is ARctic Escape, however, this game is implemented much differently than the plan for this project. ARctic Escape was implemented as a Snapchat Lens, however, the goal for this project is to create a standalone application through the Unity framework.

5.3 New Problems

The following section will describe potential problems of the application's creation. It will go over the effects on the current environment and installed system, as well as user problems and other follow-up problems.

5.3.1 Effects on the Current Environment

The application will affect the way people who are isolated/remote are able to connect with others. It will provide them with a way to interact in a more physical way than traditional video games. The study for which the application is being used will also provide valuable insight into how people interact remotely using AR tools, helping to find good principles for future games. As mentioned previously, there will not be a significant impact on those not using the application due to the minimal space requirements of the game and the warnings to be aware of ones surroundings.

5.3.2 Effects on the Installed Systems

The application will not have any effect on the mobile devices it is installed on. It will act as a standalone application on the device and should not affect any other parts of the device.

5.3.3 Potential User Problems

A potential user problem may be the difficulty in solving in-game puzzles/tasks. If tasks are too difficult to complete, it may result in users wanting to quit the game, and therefore resulting in a decreased level of social interaction. Additionally, if the tasks are too easy to solve, this may also reduce the level of social interaction as users will not need to communicate as much. This may also result in users not enjoying the play.

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

It is assumed that users will be able to use the application in an area with internet connection, however, it is not unusual that people may have Internet issues, which may cause them to lose connection to the Internet. This results in a problem as without Internet connection users will disconnect from the host server, causing them to not be able to play the game or interact with their partner.

5.3.5 Follow-Up Problems

Other problems include if libraries used in the creation of the application get updated while the project is ongoing. This may result in certain in-game functionality not behaving as intended. Another problem that may arise is if users are able to find ways to solve tasks by themselves, without the need for interaction with others. The main purpose of the application is to have social interaction between users, and this would result in users not needing to communicate with each other.

5.4 Tasks

The following section will go over the planning of the project.

5.4.1 Project Planning

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

Revision #	Deliverable	Due Date
Revision 0	Hazard Analysis	October 20, 2023
	V&V Plan	November 3, 2023
	PoC Demo	November 13-24, 2023
	Design Document	January 17, 2024
	Revision 0 Demo	February 5-16, 2024
	V&V Demo	March 6, 2024
Revision 1	Final Demo	March 18-29, 2024
	EXPO Demo	April, 2024
	Final Documentation	April 4, 2024

5.4.2 Planning of the Development Phases

The development of the project will be split into three phases:

- Creation of a proof of concept and documentation
- Initial development of the application with consideration to PoC
- Refinement of application and documentation after user feedback

The creation of the proof of concept demonstration will aid in overcoming the main challenges of the system. It will demonstrate the ability for multiple users to interact in AR, and provide the documentation for the future application to be developed.

The initial development of the application will take the design of the PoC and improve on the concepts. Four puzzles will be implemented, and the multiplayer functionalities will also be implemented. The Save/Load game functional requirements and the hint and skip system will not be required for revision 0 as they are not crucial parts of the overall system. The stakeholders will be able to see the implementation and provide feedback.

The refinement will take all the user feedback and improve on the initial design. There is no expectation for major features to be developed at this stage, just improvements on the existing system and the addition of potential stretch goals.

5.5 Requirements Phase-In Plan

Requirements	Priority	Deadline
CG1	High	Nov. 1, 2023
CG2	Medium	Dec. 31, 2023
CG3	Medium	Dec. 31, 2023
CG4	Low	Mar. 18, 2024
CG5	High	Nov. 13, 2023
JG1	High	Nov. 8, 2023
JG2	Medium	Dec. 31, 2023
JG3	Low	Mar. 18, 2024
JG4	High	Nov, 13, 2023
JG5	High	Nov. 8, 2023
RS1	Medium	Feb. 5, 2024
RS2	Medium	Feb. 5, 2024
RS3	Low	Mar. 18, 2024
RS4	Medium	Feb. 5, 2024
ER1	Medium	Feb. 5, 2024
ER2	Medium	Feb. 5, 2024
ER3	Medium	Feb. 5, 2024
ST1	High	Nov. 1, 2023
ST2	High	Nov. 13, 2023
ST3	Medium	Feb. 5, 2024
ST4	High	Nov. 13, 2023
PI1	Medium	Dec. 31, 2023
PI2	Medium	Dec. 31, 2023
PI3	Medium	Dec. 31, 2023
PI4	Medium	Dec. 31, 2023
HR1	Low	Mar. 18, 2024
HR2	Low	Mar. 18, 2024
HR3	Low	Mar. 18, 2024
SP1	Low	Mar. 18, 2024
SP2	Low	Mar. 18, 2024

Table 7: Requirements Phase-In Plan Part 1

Requirements	**Priority**	**Deadline**
SM1	High	Nov. 13, 2023
SM2	High	Nov. 13, 2023
SM3	High	Nov. 13, 2023
SM4	High	Nov. 13, 2023
RM1	Low	Mar. 18, 2024
RM2	High	Nov. 13, 2023
RM3	High	Nov. 13, 2023
VM1	High	Nov. 13, 2023
VM2	High	Nov. 13, 2023
SS1	Medium	Feb. 5, 2024
SS2	Medium	Feb. 5, 2024
SS3	Medium	Feb. 5, 2024
SS4	Medium	Feb. 5, 2024
SS5	Medium	Feb. 5, 2024
SS6	Medium	Feb. 5, 2024
SS7	Medium	Feb. 5, 2024
MP1	Medium	Feb. 5, 2024
MP2	Medium	Feb. 5, 2024
MP3	Medium	Feb. 5, 2024
MP4	Medium	Feb. 5, 2024
MP5	Medium	Feb. 5, 2024
IP1	Low	Mar. 18, 2024
IP2	Low	Mar. 18, 2024
IP3	Low	Mar. 18, 2024
IP4	Low	Mar. 18, 2024
IP5	Low	Mar. 18, 2024
CP1	Medium	Feb. 5, 2024
CP2	Medium	Feb. 5, 2024
CP3	Medium	Feb. 5, 2024
CP4	Medium	Feb. 5, 2024
CP5	Medium	Feb. 5, 2024
CP6	Medium	Feb. 5, 2024

Table 8: Requirements Phase-In Plan Part 2

Requirements	Priority	Deadline
WP1	Medium	Feb. 5, 2024
WP2	Medium	Feb. 5, 2024
WP3	Medium	Feb. 5, 2024
WP4	Medium	Feb. 5, 2024
WP5	Medium	Feb. 5, 2024
WP6	Medium	Feb. 5, 2024
WP7	Medium	Feb. 5, 2024
WP8	Low	Mar. 18, 2024
WP9	Low	Mar. 18, 2024
WP10	Low	Mar. 18, 2024

Table 9: Requirements Phase-In Plan Part 2

High priority requirements make up the core components of the game, without which the game would not be playable. These are also requirements the development team was most concerned about implementing for the proof of concept.

Medium priority requirements are game mechanics that create the structure of the game and make it fun to play by creating the flow of the game and adding puzzle variability.

Low priority requirements are add-ons that contribute to ease-of-use of the game and quality of life. They're not strictly necessary, hence the lowest priority.

5.6 Risks

The main risks of the project are:

- Users losing awareness of their surroundings and potentially getting injured
- Server overload could cause lag in gameplay, resulting in an unpleasant user experience
- Potential data loss if the server storing saved game data malfunctions/breaks
- Failure to meet deadlines will cause setbacks for the project. In the event of this, some requirements might not be met, and documents will have to be modified to reflect this.

5.7 Costs

There is no financial costs associated with the development of the application, and there is no cost for users downloading and using the application. Furthermore, the time to development time is estimated to be six months, with work being divided amongst four developers.

5.8 User Documentation and Training

The following section will go over any training and documentation that is needed for users, as well as waiting room ideas and ideas for implementation

5.8.1 User Documentation Requirements

The users will have a user help document available to them within the application in the form of a gameplay menu. It will contain information on how to use the application, as well as any instructions regarding interacting with puzzles/tasks.

5.8.2 Training Requirements

The users will have a "tutorial" when they first start the game that will teach them how to use the application. It will show the users how to use AR technology, and give them a simple puzzle to solve.

5.9 Waiting Room

There are currently no requirements or functionalities that are not being included in the initial release. Future ones may be added later on.

5.10 Ideas for Solutions

During the requirements and idea generation phases, additional ideas were generated on how to implement the solution.

- Form
  - Since the application will be developed using Unity framework, the idea of using Unity based libraries and plugins for AR framework such as AR Foundation and Zed-Rig.

6 Appendix

This section will be used to capture miscellaneous information that couldn't easily be fit into the rest of the document.

6.1 Reflection

A new and unique set of skills will be required for the completion of this project. It is hoped that the entire team will have an exposure to everything listed below, but the team members in charge of fostering the skill and development of the sections that require it are also listed.

RS1 **Mobile App Development**: Developing a mobile application presents unique challenges that aren't present when developing a standard computer application. Dealing with limited memory and processing power, navigating the licensing and system requirements for different devices, and fully utilizing the tools embedded in phones are all skills that will need to be developed over the course of the project.

- **Main Team Members**: Sam, Matthew

RS2 **Augmented Reality**: Integrating AR into an application requires an understanding of how to get a piece of software to integrate with the real world. Team members will need to learn how to make the tool process the readings from various video and location instruments, calculate how to place objects into a 3D space, and give the user the tools to manipulate the world through their augmented view.

- **Main Team Members**: Kieran, Ethan, Sam, Matthew

RS3 **Communication Services**: Allowing different devices, running on different types of software to communicate with each other over long distances is a vital part of capturing the collaborative aspect of the project. The team will need to investigate how to accomplish this networking.

- **Main Team Members**: Kieran, Matthew

RS4 **Location Services**: Tracking the location of the user and integrating nearby landmarks in real time adds additional depth to the tool. A vital skill will be getting the tool to interface with existing location services.

- **Main Team Members**: Ethan, Sam

RS5 **Game Design**: Getting a large and diverse user base is essential for the collaborative aspect of the tool. Researching what makes a game fun to play and striking a balance between the difficulty and complexity of the puzzles is what will drive this engagement. We will acquire these skills via the unity forums and various unity tutorials found on YouTube.

- **Main Team Members**: Kieran, Ethan

6.2 Symbolic Parameters

There are currently no symbolic parameters that need to be recorded for this document. Any future symbols will be recorded in the following table:

Symbol	Value	Description

References

Michael Cooper. Wcag 2.1. https://www.w3.org/TR/WCAG21/, 2023.

Entertainment Software Rating Board, 2024. *ESRB Ratings Guide*, 2024.

Theodore Knoll, Amna Liaqat, and Andres Hernandez. Arctic escape: Promoting social connection, teamwork, and collaboration using a co-located augmented reality escape room. https://dl.acm.org/doi/10.1145/3544549.3585841/, 2023.

James Robertson and Suzanne Robertson. *Volere Requirements Specification Template*. Atlantic Systems Guild Limited, 16 edition, 2012.