

**NANYANG
TECHNOLOGICAL
UNIVERSITY**
SINGAPORE

IM3080 Design and Innovation Project

(AY2023/24 Semester 1)

Project Report

Title: ARvatar

Github: <https://github.com/LiTianchu/NTUDIP.git>

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1. Background and Motivation

1.1 Background

With the advent of digital communication, there has been a rising demand for innovative messaging platforms. While conventional text-based messaging apps have been consistently proving their efficacy, it is widely acknowledged that they frequently fall short in delivering the desired personal touch in user interactions. The evolution of technologies, notably augmented reality (AR), opens up exciting possibilities to enhance and improve user interaction with messaging platforms.

1.2 Motivation

The motivation behind our project stems from a desire to address the limitations inherent in conventional messaging apps through the exploration of 3D avatars and augmented reality (AR). The contemporary landscape of messaging platforms has underscored the significance of visual communications, with emojis, GIFs and stickers serving as examples that facilitate a more nuanced expression of emotions than textual content alone. This visual necessity was thus an important factor in choosing to incorporate 3D avatars integrated with AR technology.

Integrations of avatars, particularly in a three-dimensional format, hold the potential to provide users with a customisable representation of themselves, thereby enhancing the capacity for self-expression. Moreover, implementing AR would allow our users to not only view their personalised avatars in their immediate surroundings but to also interact with them in a more immersive, personal manner.

2. Objective

Our project's primary goal is to develop a chat application that incorporates 3D avatars and Augmented Reality (AR) interactions. Our goals encompass the following key aspects:

- Chat Application with basic messaging functions and authentication
- Special features including 3D Avatars and AR Chat Room

3. Review of Literature/Technology

3.1 ChatApps

In examining popular messaging applications such as WhatsApp, Facebook Messenger, and WeChat, it becomes evident that these platforms have thrived on their ability to facilitate seamless text-based conventional messaging applications. Analysing the features of these apps helps in providing valuable insights into the preferences and behaviours of current users, thereby allowing us to highlight the strengths and weaknesses of conventional text-based communication. This will in turn allow us to generate innovative ideas of adding newfound features into these texting applications.

3.2 Use of Avatar

Bitmoji stands out as an example of incorporating avatars into communication. By allowing users to create a personalised cartoon avatar that mirrors their physical characteristics and expressions, Bitmoji provides a platform for users to express themselves digitally. Exploring user feedback on Bitmoji helps in providing more insights into the impact of 3D avatars on user engagement and emotional expression within the context of messaging applications.

3.3 Use of AR

Applications such as GIPHY World have ventured into the use of Augmented Reality (AR), which adds a new dimension to digital communication. AR features in communication applications provide a platform for users to have more interactive and immersive experiences. By examining the user experience with AR features in messaging platforms would aid in highlighting the possible advantages of integrating AR into social interaction, contributing to a better understanding of the evolving landscape of digital communication.

3.4 Use of Cloud Service

Firebase emerged as our preferred choice for its seamless integration capabilities. It offers a real-time NoSQL database that enables instant updates and synchronisation of data across all connected clients. This feature is crucial for chat applications, as it ensures that messages are delivered and displayed in real-time, creating a seamless and responsive user experience. Moreover, Firebase is free to use for smaller projects like ours, while also being able to scale when our project gets larger and has to handle increased loads.

3.5 Use of Unity

The decision to employ Unity as our project's development framework stems from its myriad benefits that align perfectly with our goals. Unity's advanced cross-platform capabilities ensure the broad accessibility of our messaging application, accommodating users on various devices seamlessly. The engine's ability to craft immersive user interfaces enhances the visual appeal and user-friendliness of our application, crucial for an engaging messaging experience. Leveraging Unity's prowess in handling realistic animations and 3D environments, we can seamlessly integrate lifelike avatars, elevating the dynamism of user interactions. The developer-friendly environment and widespread adoption of Unity expedite our development process, ensuring efficiency and compatibility with industry standards. In essence, Unity emerges as the ideal choice, providing a versatile and robust foundation for our project objective—an innovative and interactive messaging platform that transcends conventional boundaries.

3.6 Gaps in Current Technology

The current gap in avatar technology within messaging applications, characterised by predominantly 2D avatars, restricts the immersive potential of user interactions. Recognizing user preferences for enhanced customization and the limitations of existing avatars underscores the need for innovation. Our project's primary objective is to bridge this gap by introducing 3D avatars coupled with Augmented Reality (AR). This strategic combination aims to not only elevate the user experience but also provide a dynamic and personalised interaction within the messaging environment. The integration of AR further enhances the visual dimension, propelling digital communication into an era where user expression extends beyond two dimensions, offering a more immersive and authentic communication experience.

4. Design and Implementation

4.1 Design Consideration / Choice of Components

4.1.1 Colour Scheme



- Colour scheme: Serenity and Rose Quartz
- #FFDAD6, #FFC0BE, #90C2FF, #A68BDB

4.1.2 Font

Comfortaa-Light.ttf
Comfortaa
 Comfortaa-Regular.ttf
Comfortaa
 Comfortaa-Bold.ttf
Comfortaa

The application primarily utilises the 'Comfortaa' font, characterised by a minimalist sans-serif style marked by soft, rounded edges and inherent simplicity. This font is particularly well-suited for our application, given its clear legibility and visually appealing characteristics.

4.1.3 Theme/Concept

For our theme and concept, we opted for endearing cartoon animals as avatars. This choice is rooted in the widespread fondness people have for animals, offering a delightful and universally appealing option for customization and self-expression. Beyond the conventional selection of accessories, hats, and shoes, our avatars, being animals, provide an added layer of personalization. Users can explore various fur colours and patterns, significantly expanding the spectrum of options for customising their avatars and allowing them to uniquely represent themselves in the digital realm.

4.1.4 Logo



ARvatar

The logo draws inspiration from a default chat bubble icon from our application, seamlessly merging it with minimalist animal ears to symbolise our app's Avatar functionality. Coloured with our selected palette, this icon serves as a distinctive representation of our app, encapsulating its essence effectively.

4.2 Final Design

To model the application's requirements comprehensively, we designed the following UML diagrams, providing a detailed representation in the Appendix section (refer to Section A for the complete diagrams):

- **Use Case Diagram (See Appendix)**

This diagram illustrates the various interactions between users and the system, capturing the key functionalities and scenarios within the application.

- **Activity Diagram (See Appendix)**

The activity diagram maps out the flow of activities and processes within the application, showcasing the sequential steps and decision points involved in different user scenarios.

- **Entity Relationship Diagram (See Appendix)**

This diagram outlines the relationships and connections between different entities in the application, providing a visual representation of the data structure and its dependencies.

4.3 Implementation

Description	Screenshots
Welcome Page	
Authentication Page <ul style="list-style-type: none"> ● Login ● Register ● Reset Password 	<div data-bbox="510 914 829 1503"> <p>Register your email</p> <p>ARvator will need to verify your account. Carrier charges may apply.</p> <p>Singapore your email your password</p> <p>Already have an account? Tap here to Log In</p> <p>Next</p> </div> <div data-bbox="829 914 1147 1503"> <p>Log In</p> <p>ARvator will need to verify your account. Carrier charges may apply.</p> <p>Singapore your email your password</p> <p>Dont have an account? Click to Register Forget Password? Press Here</p> <p>Next</p> </div>

<p>Main Page</p> <ul style="list-style-type: none"> • Chat list • Search for User • View friend requests • Set colour theme • Initiate new Chat • Open AR mode • Sign Out 	<p>The screenshot shows the main page of a mobile application. On the left, there's a vertical list of recent chats with small profile icons and names like Alan, MK, Aloy, Aether, yuyang, Tionchu, and Benjamin. On the right, a sidebar menu is open with options: Search, Friend Requests, Edit Profile, Dark/Light Mode, and Sign Out. Below the menu, a message from 'Aloy' is visible: 'If you're looking for a translation, it's in the text written by a Roman Scholar'.</p>
<p>Edit Profile & Customizing Avatar</p> <ul style="list-style-type: none"> • Change username and status • Change avatar skin color, texture, accessories 	<p>The screenshot shows two screens for profile editing. The left screen, titled 'Edit Profile', shows a white cat-like character with pink ears and a pink belly. Below it are buttons for 'Group 6' and a message 'Hi we are grp 6!!!'. The right screen, titled 'Customisation', shows a blue cat-like character with a yellow crown and a white chest. It includes a 'Save' button and a row of icons for customizing skin, texture, and accessories.</p>
<p>Chat</p> <ul style="list-style-type: none"> • Send emoji • 3D avatar Animation • Send text message • View previous message histories 	<p>The screenshot shows a chat interface between 'Aloy' and 'Group 6'. The messages include text and 3D avatars of foxes. One message from 'Group 6' contains Latin text: 'It was originally taken from a Latin text written by a Roman Scholar. Philosopher by the name of Marcus Tullius Cicero, who influenced the Latin language greatly.' Below the messages is a message input field with a placeholder 'Enter text...' and a send button.</p>

<p>ChatAR</p> <ul style="list-style-type: none"> • Plane Detection • Placing Avatar • Chatting with friends 	
<p>Sample scenes of Dark Mode</p>	

4.4 Technologies Used

Tech	Type
Framework	Unity3D 2022.3.9f1
Database & Authentication	Firebase
3D Modelling & Animation	Blender
Textures	Adobe Substance 3D Painter
2D Graphics	Figma, Adobe Illustrator, Clip Studio
IDE	Visual Studio 2022
Programming Language	C#
Unity Plugins	AR Foundation, Google AR Core, Dotween, XR Simulation Environments
Android Build Environment	OpenJDK 11, Android SDK API 32, Gradle 7.2

Due to the use of AR and 3D models in our application, we used Unity3D Game Engine as the main development framework for the application, which has powerful support for building AR and 3D applications. The Game Engine is used together with plugins, including AR Foundation and AR Core (For AR implementations), Dotween (For UI Effects), and XR Simulation Environment (For Testing AR).

For art asset creation, used Blender, which is a free 3D modelling software, to create the models. The model texture mapping is created using Adobe Substance 3D Painter. 2D art assets such as UI sprites and 2D profile pictures are created using digital drawing tools such as Figma, Adobe Illustrator, and Clip Studio. The architecture diagram is shown in Appendix Section A.

4.5 Discussion

In our implementation of a 3D chat app, we have successfully addressed limitations in conventional messaging platforms by introducing 3D avatars and Augmented Reality (AR). Leveraging Unity3D Game Engine, Firebase for real-time synchronisation, and tools like Blender and Adobe Substance 3D Painter for asset creation, our application provides users with a more immersive and personalised communication experience. The integration of 3D avatars enhances user expression, allowing users to represent themselves. AR breaks

through the wall of reality and virtual scene, which brings users together across the internet. Our project creates an innovative way of building digital communication platforms, breaking the boundaries of tradition.

5. Conclusion and Recommendation

5.1 Conclusion

Our project, ARvatar, has achieved significant milestones, successfully integrating 3D Avatar customization and AR chat functionalities into a cohesive chat application. Through thoughtful design and implementation, we have addressed the limitations of conventional messaging apps, providing users with an innovative platform that goes beyond textual communication. The incorporation of 3D avatars and AR has enhanced user interaction, allowing for more personalised and immersive experiences.

5.2 Recommendation for Future Works

For future developments, we propose expanding the customization features to include a broader range of accessories, gestures, animal types, expressions, and clothing. This would offer users even greater control over their avatars, fostering a more diverse and expressive digital representation. Additionally, investigating collaborative AR experiences, where multiple users can interact with each other's avatars in a shared space, holds the potential for creating a more communal and engaging user environment.

The exploration of ARvatar provides a strong foundation for continuous improvement and innovation in the realm of augmented reality and 3D avatar integration within messaging applications. As technology evolves, we anticipate the opportunity to introduce cutting-edge features that push the boundaries of digital communication, ensuring ARvatar remains at the forefront of user-centric and visually dynamic messaging experiences.

In conclusion, ARvatar marks a significant step forward in redefining the landscape of messaging platforms, and we look forward to further enhancing the application based on user feedback and emerging technologies.

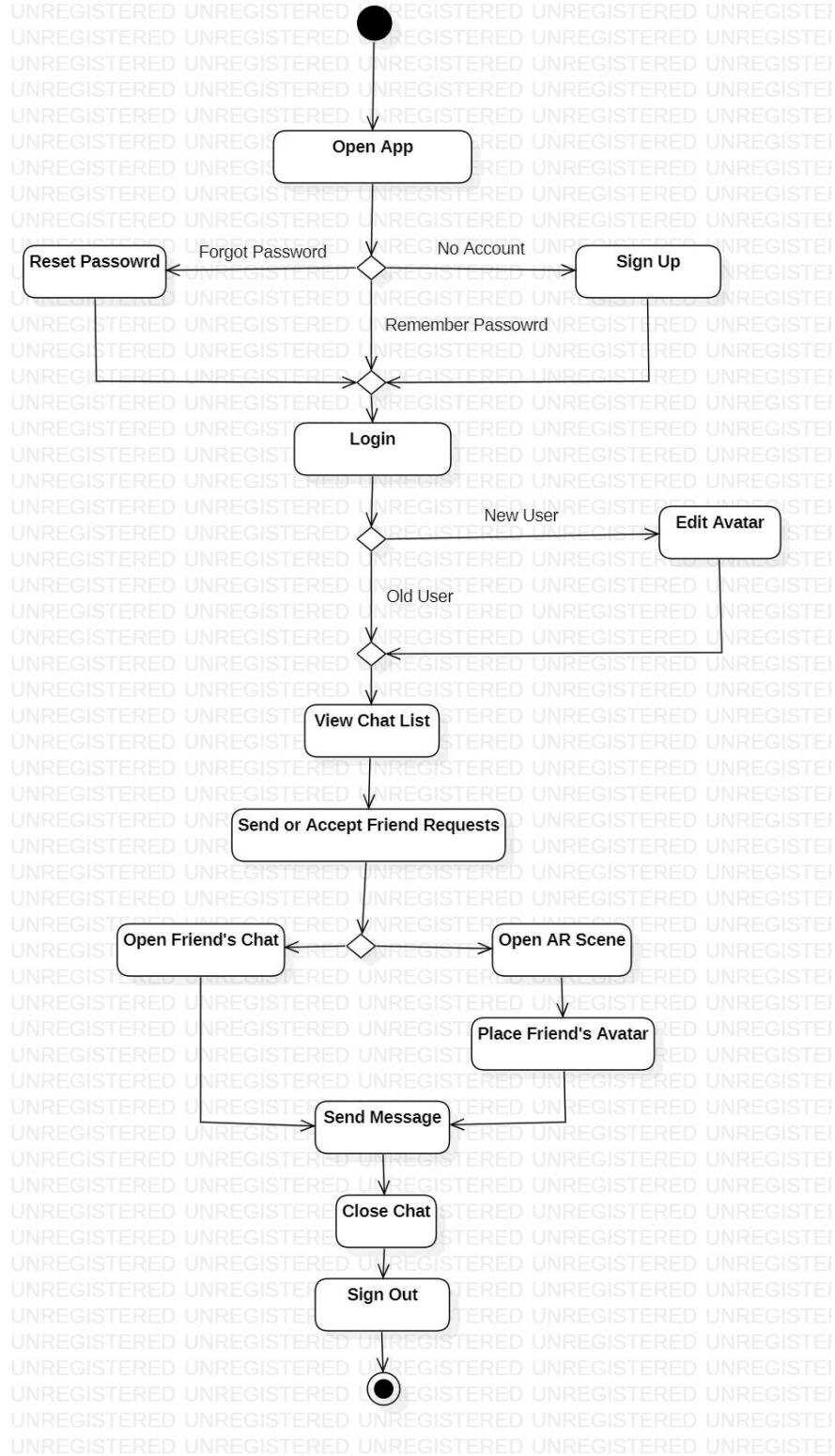
Appendices

A. Design Diagrams

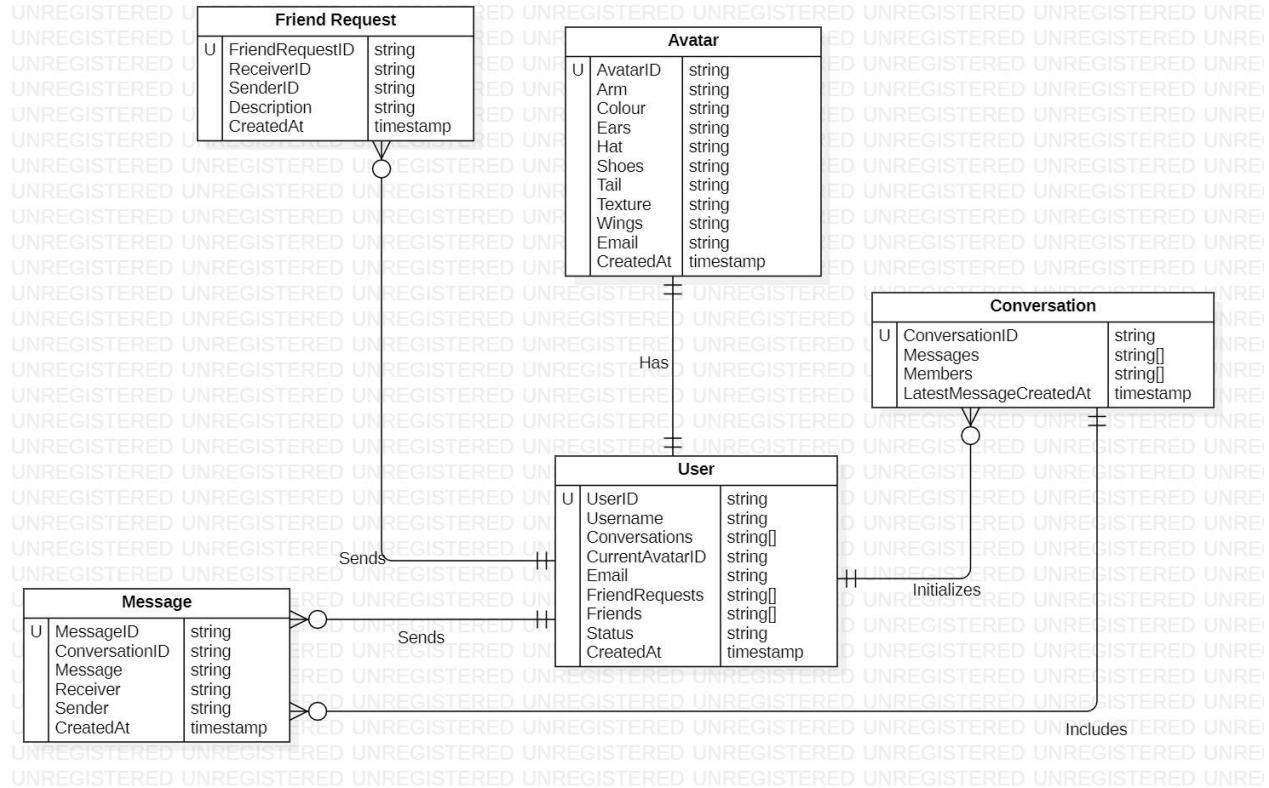
1. Usecase Diagram



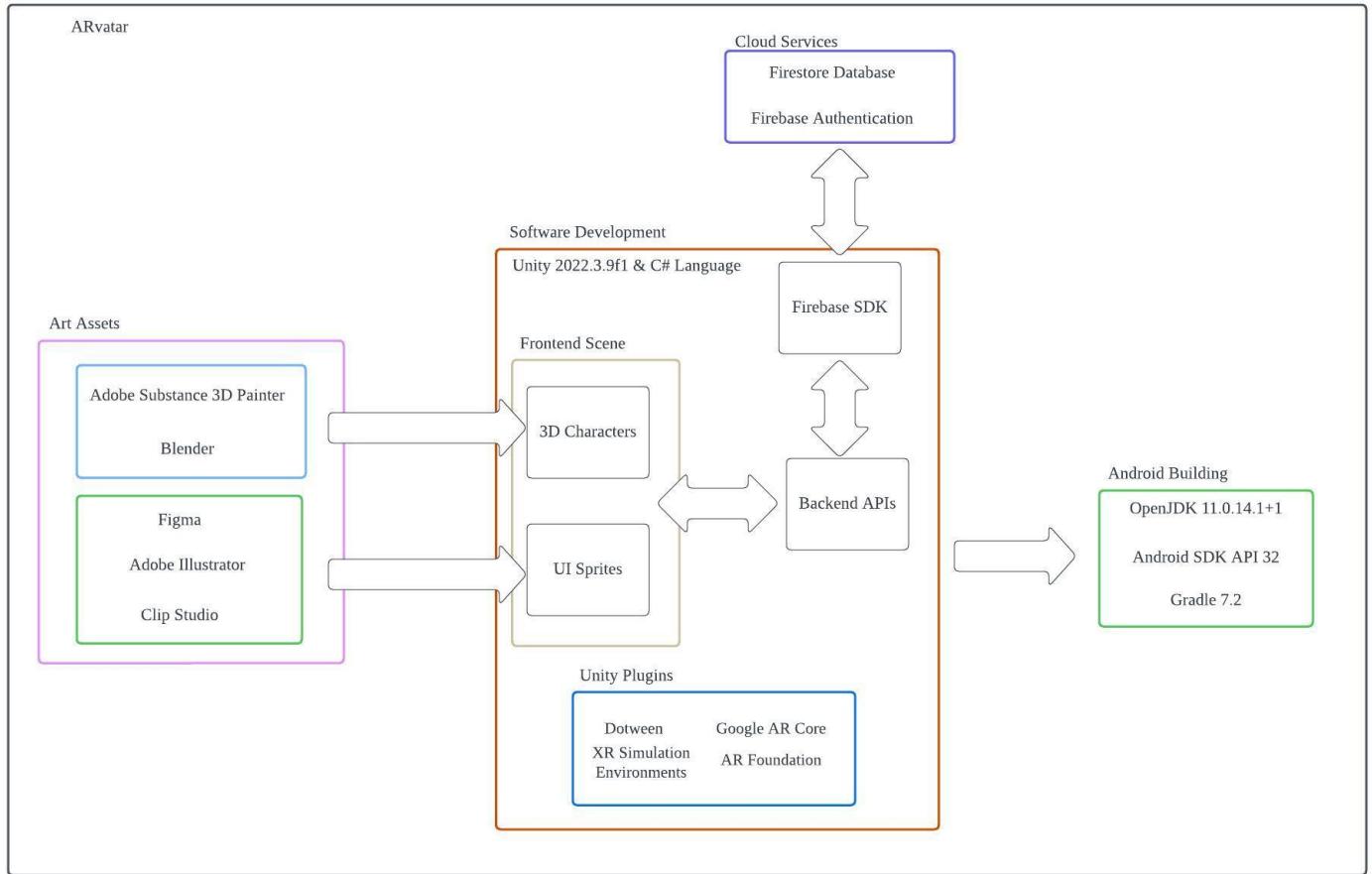
2. Activity Diagram



3. Entity Relationship Diagram



4. Architecture Diagram



B. User Guide

First Time Using:

1. Agree with Terms and Conditions
2. Register for an account using an email address
3. Confirmation will be sent to the provided email address, verify it in the email
4. Login to the App with the account just verified
5. Edit their username and status
6. Create a 3D Avatar.

To Send a Friend Request:

1. Tap on the hamburger button at the top right corner, select “Search”
2. Search for a user using an email address, add him/her as a friend
3. Wait for the user to accept your request

To Receive a Friend Request:

1. Tap on the hamburger button at the top right corner, select “Friend Requests”
2. If you see a friend request record, you can select “accept” or “reject”

To Send a Message to a Friend:

1. If you have not initiated a chat with that friend, tap on the chat bubble icon at the bottom right side of the chat list page
2. Select the friend you want to chat
3. Input a message by tapping on the input box
4. Or select an emoji by tapping on the “+” button
5. Send by tapping on the right arrow

To use the AR Chat Room:

1. Open the AR scene by tapping on the “AR” button at the bottom left side of the chat list
2. Tap on “Avatar Friends” to show your friends’ avatar
3. Tap on one of the avatar Icons, planes should appear in your phone camera image (if not can try to move your camera or wait for a while)
4. Tap on the plane to place the avatar, you can place multiple avatars at the same time (Each avatar has its account name on top)
5. Tap on the avatar to select who you want to talk to and a message log will show up

C. Maintenance Guide

To set up the project

1. Download Unity3D and Visual Studio
2. Install Unity Editor 2022.3.9f1 or higher, and select Android Build Support while installing, make sure that OpenJDK and Android SDK are checked
3. Install AR foundation, Google AR Core XR Plugin, and XR Simulation Environments using Unity Package Manager if not installed
4. Install Dotween from the Unity Asset Store if not installed
5. Download google-services.json from Firebase App Console, and put it under Both the Asset Folder and Assets/StreamingAssets Folder
6. To set up for simulator testing, go to Build Settings -> Switch platform to Android
7. After that, go to Player Settings -> XR Plugin Management make sure that XR Simulation under the Desktop Tab and Google ARCore under the Android Tab are checked

D. Software Development Cost

No. of people worked = 9 People

No. of hours per each person = 9 hrs * 13 weeks = 117 Hours

Man Hour = 9 * 117 = 1053 Man-Hour