Virtual Room: Project Report

Prepared by
Alekh Meka, Ayaan Siddiqui, Karan Vishwakarma and Maseeh Khan

University of Illinois Chicago
February 2021

Table of Contents

List of Figures

List of Tables

I Project Description

1 Project Overview

Virtual Room is a product that utilizes the tools found in Machine Learning and Software Engineering. The main objective of Virtual Room is to provide a virtual environment for users to enhance their communication and interaction with other users while in the comfort of their home, also following safety guidelines. Since Virtual Room is based around COVID, we ensure the safety and social distancing norms of the COVID-19 pandemic while enabling realistic interaction among users.

2 The Purpose of the Project

Due to the emergence of the COVID-19 pandemic, people have to emulate the strict principles of social distancing to avoid spreading of the virus. This had a tremendous impact on the social, emotional and professional lives of the people. With every activity carried out through the internet, group activities have been lost and cannot be carried out, and even if they are, the dynamic is much different and creates lots of complexities. Virtual Room was designed with this in mind, and therefore, helps to provide a solution to bridge this gap in society.

2a The User Business or Background of the Project Effort

Users could utilize Virtual Room for personal and professional uses. In terms of professional / business use, Virtual Room can be utilized to simulate a courtroom for example.

Content

Lawyers, judges, defendants, the jury and the judiciary system at large would benefit greatly from a virtual courtroom setting.

Motivation and Considerations

Currently, while we are in the midst of a global pandemic, courtrooms in the United States have been closed and hearings are taking place virtually via zoom. However, this is very limited and only allows a few people to see each other's faces. Even if you were to have the jury and more than 15 users participating for example, a single user can only focus on one person at a time. If they are used to the zoom format, they might be able to fit 4 users on their screen, while seeing and hearing everyone adequately. With Virtual Room, you can have everyone present and participating in one room. The judge can look between the lawyers and the defendants with ease, the lawyers can freely present their evidence to all spectators and the jury will clearly be able to observe the trial.

2b Goals of the Project

People all round the world have been adversely affected by the pandemic in various aspects like socially, emotionally etc. Not being able to meet their loved ones had separated people and caused many problems. Keeping this problem as a foundation, a virtual room helps to enhance the mental and physical well being of the users and provide a virtual environment where people can interact with each other efficiently.

Content

Virtual Rooms help in providing a user friendly virtual environment for people to gather and interact with their family and friends, to keep in touch with colleagues, and add a different dimension to their lives affected by COVID-19.

Motivation

Through our product, a virtual environment would be set up to enhance the communication between the different users. Virtual Rooms would be able to balance their social and emotional wellbeing of a person and keep his or her life connected with the world. To ensure the scalability of the product, the architecture of the product will be able to support any environment where the user is in currently.

2c Measurement

The main goal of Virtual room revolves around customers well being from pandemic and providing an environment having enhanced tools for communication. Keeping the customers satisfaction as a priority, Virtual rooms will ensure a constant service to the users. Special hardware gloves equipped with tactile sensors will be made available online for people to purchase. These gloves will be used to enhance the user experience during the virtual environment.

Users will be able to rate the product and provide feedback on various aspects based on aspects like Usability, durability of the product, on the website etc. These statistics will help our team to get a comprehensive report on the product. Additionally, the mobile application will request the users to give feedback after every 15 days with questions on their current health status. These checks will help us estimate the total number of users who are safe from covid and they are able to remain unaffected after 15 days. This percentage will help us to ensure whether we are able to fulfill our goals of our product and team.

3 The Scope of the Work

As Virtual Room is a very versatile product, the scope of it's work is quite broad. It will be used for personal and professional use. The product itself can be used in any location.

3a The Current Situation

In order to meet their regular requirements for work, school, or personal matters during this global pandemic, people are scheduling meetings on online platforms like Zoom, Google Hangouts and Microsoft Teams. Schools, like our school University of Illinois at Chicago, have been using platforms like blackboard and acadly.

Content

These platforms all work very similarly. Users will join a virtual meeting with 1 or more people and communicate via their phone or computer's audio. They also have the option to turn their camera on. While this method of communication is greatly improved over just having a chat forum or email thread, it is not ideal for many of our use cases today.

Motivation and Consideration

These platforms provide a basic interaction but lack a lot of aspects which are included in personal meetings. A lot of people still feel disconnected, as all they see during these meetings is the other person's face, if their camera is on, or their voice. For many meetings and events, just seeing a video feed of someone's face is not sufficient. Courtroom sessions, as we mentioned earlier, fall into this category. Another prime example would be sporting events, such as NBA games or NFL games.

3b The Context of the Work

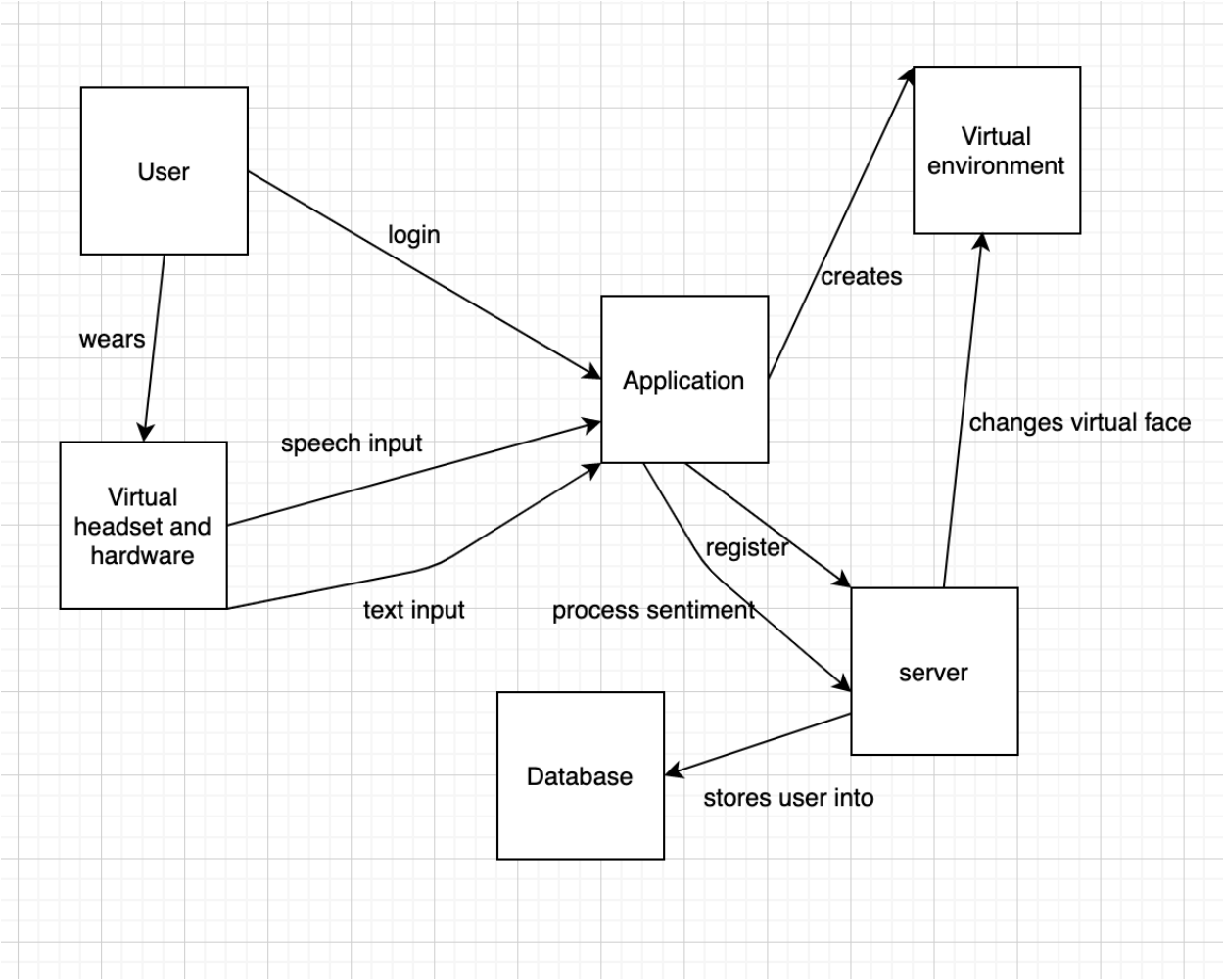


Fig 1.1: Working environment of components

3c Work Partitioning

The work that the user would have to do is very simple. They would download the application on their phone, tablet, or computer. They would then sign up using their email address or phone number initially. If the user is signing into an organization (work or school for example) , then they would use their work / school email. There would be a device that comes with a virtual room (a small hand-sized device) that one would place down to virtually simulate whatever environment / meeting that they will be joining or hosting. The users can then create or join a meeting via the application. When they have finished, they will close the application.

3d Competing Products

Currently virtual room has no real competing products. If you want to consider alternatives to what virtual room provides, zoom and the meeting programs we mentioned earlier can be mentioned, so we will address them as if they were competing products.

Content

Zoom, Blackboard, Google Hangouts, and Microsoft Teams can be used to hold virtual meetings. However, as we mentioned earlier, they are very limited. The maximum interaction you will have is hearing their voice, seeing their face, and seeing their screen if they share it to present something for example.

Motivation

If the customer wants more interaction in their meetings, or for example if the customer is a whole organization and wants the option of having more interactive meetings available for all of their employees, then they will choose our product. If they are content with the limited communication present in Zoom for example, then they might stick to Zoom.

Considerations

One option we might be able to incorporate within our software, is the option to have basic virtual meetings like Zoom and Microsoft Teams do. If the employees of a business want to have a quick short meeting that doesn't require the full features of Virtual Room, then they are able to do so. Having this option, along with competitive pricing, will give us the edge over these other platforms.

4 The Scope of the Product

Let's consider a scenario where a family continues the tradition of celebrating a holiday at their grandparents house, where all the members of the family come over from different states to celebrate and get together. However, due to the COVID restrictions they will not be able to gather at one place. In this case, with the current services we have available, the closest this family can get to experience their face to face gatherings would be via video conferencing, with products like Zoom, Skype, etc. This where Virtual Room truly shines as a very unique platform that aims to solve these problems. In this case, the user can create a virtual environment using the phone camera and recording the environment he/she wants the meeting to be, they will also be able to add props, games, movies, and any other form of entertainment. Once the environment is set up, they can invite friends and family to join in. Once everyone is connected, they will be able to fully interact with other members present in the room, this provides a much better experience than just a regular video conference, as Virtual Room offers interactive VR games, movies that everyone in the room can watch in sync, etc.

4a Scenario Diagram(s)

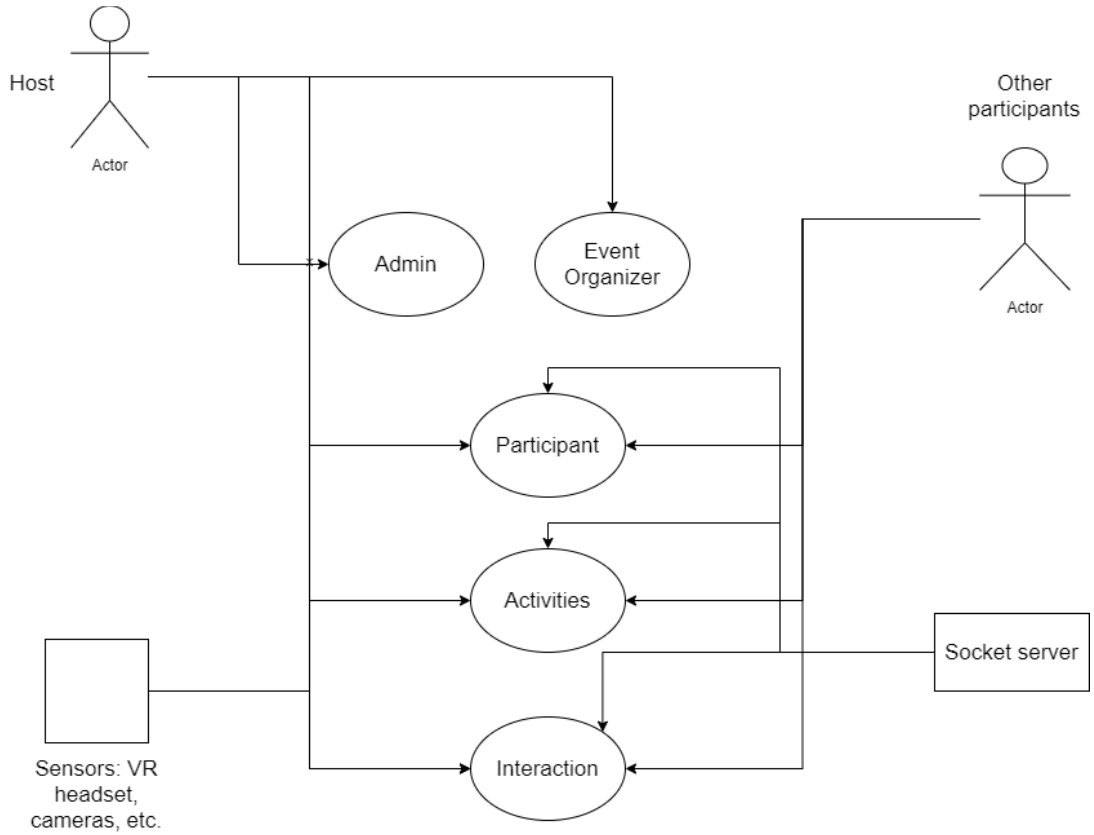


Fig 1.2: Scope event scenario diagram

4b Product Scenario List

Scenario	**External actors**
Birthday party	Users attending the party, VR sensors, camera, DB, socket server to connect users
Sporting event	Players, teams, event organizers, advertisers, audience, servers, interactions with other members, special VIP seatings
Wedding	Bride, groom, audience, programs, event organizer

4c Individual Product Scenarios

- **Birthday party scenario:** In this scenario, we have a different audience and the person(s) whose birthday it is. In addition to this, we also have events in this party, games, and other activities created by an admin, host, or event organizer.
- **Sporting event:** In this scenario, we have a sports event, like the Super Bowl. In such a large scale event, there will be thousands, if not millions of people. In such a scenario we will have hundreds of advertisements, halftime shows and other activities. In events that are this large there will be teams of event organizers, team of admins, and a team of hosts. There will also be special VIP audience members.
- **Wedding event:** In this scenario, we have a wedding with a bride, groom, audience, admins, event organizers, hosts, and other special positions can also be assigned by the admins, and hosts. The admin, host and event organizers create and set up the main wedding event. The audience will be able to see the entire event also take part in all the other activities, like cutting the cake, ring ceremony, and any other cultural parts added as activities by the event organizers.

5 Stakeholders

Virtual Room consists of a variety of stakeholders involved in the product and its development for the future. Individuals and families can choose to purchase the product for personal communication needs. Businesses and corporations can supply their employees or audience with Virtual Room so that they can efficiently convey conversations.

5a The Client

This project consists of several clients that could potentially invest in this product. Since precision and accuracy are a high priority for our machine learning algorithm, we hope to attract clients that have a strong reputation for research in those domains.

Content

Being the leader in machine learning, Google is the prime target for our project. Artificial Intelligence is a very strong research domain at Google. Another potential client is Facebook because of their recently made VR headset “Facebook Oculus”. We believe that both clients can provide the resources necessary to develop a high quality product that meets the needs of our customers.

Motivation

Both clients will have intrinsic and extrinsic motivation for developing our product. Since the ideals of Google and Facebook center around improving the well-being of individuals in society, they will be intrinsically motivated to create a product that can significantly improve the quality of virtual communication. They will also be extrinsically motivated because this is a huge opportunity to create a product that will be in demand by personal users as well as by businesses. Ideally the primary objective at launch will be to improve productivity in the workplace. This will be

easily testable to show the tangible benefit it can provide to a business. Once there are enough statistics to show a strong correlation between our product and improved communication, we can launch for personal use.

Considerations

Our product is focused heavily on providing a high-quality holographic rendering for each user. We want to create a realistic experience that envelops our user into a familiar environment. Although initial costs may be expensive, the objective is to provide the highest quality communication mechanism available in the market.

5b The Customer

Our product targets several types of consumers. Business consumers will provide most of the sales but personal consumers will also obtain a huge benefit from purchasing our product.

Content

Our initial customers will be 3rd-party business entities with the end user either being the customers of an event or the employees within the company. Virtual Room is intended to be used for large social gatherings such as the Superbowl. Virtual Room is also used for communication between the employees in the firm. The other type of customer that our product hopes to cater to is personal users. With our virtual reality rendering, we can connect individuals in a family together regardless of the distance between them.

Motivation

Since the client will be either Facebook or Google, we will provide productivity statistics from the use of Virtual Room at the company offices. After those statistics have been generated, we hope to sway other companies to purchase Virtual Room for the productivity needs of their employees. The value this product brings to the communication between the organization greatly outweighs the cost to purchase it for each employee. For personal users, they will be motivated to purchase this product if they want to have realistic, high-quality experiences with their loved ones that live far away.

5c Hands-On Users of the Product

Content

1. User name/category: Attendees of a social event

   User role: The typical social event such as the Superbowl is very dangerous amid the current pandemic. The user can avoid the dangers while enjoying the event through our product. They will simply download the application, and launch the holographic generator that is sold with our product.

Subject matter experience: The user can be a novice and not know much about Football or the event that they are attending while still enjoying the event through social interaction.

Technological Experience: The user can be a novice at using this device and still have a memorable social experience. There will be an automated AI that you can speak to that will take care of many of the technical nuances.

Other User Characteristics: Extremely broad range of users. Initially tailored to primarily English speakers.

2. User name/category: Employees from the business entity

   User role: The employees from a business can use this product to communicate and present ideas among one another. This application should be easy to use for a non-tech savvy individual in the company. The user simply has to download an application on their phone and scan the surroundings. Then the app connects to the holograph generator and presents a display that mirrors an environment.

   Subject matter experience: The user can be a novice in the particular business that they are in and still reap the benefits of this software. This is designed to foster healthy communication that they would normally experience face-to-face. This healthy communication helps create an environment where users can effectively learn.

   Technological Experience: The user can be a novice at using the device and still manage to get a high quality experience. The software takes care of many of the nuances that come with virtual displays. However, if the user is experienced, they can make additional modifications in the settings.

   Other User Characteristics: Ideally we would be targeting this to an age group between 20-49. These individuals are typically the most reliable when dealing with technology. The benefit is that only one holograph generator is needed for a room. Thus, many of the other users will just need to download the software so that they can use it.

3. User name/category: Personal Family Users

   User role: The individuals in a family can use this product to communicate with one another despite being a large distance away from each other. The user simply has to download an application on their phone and scan the surroundings. Then the app connects to the holograph generator and presents a display that mirrors an environment.

   Technological Experience: The user can be a novice at using relevant technology but still manage to experience sentimental and valuable conversations with other individuals. There will be a separate “personal” version of the software that will be more user friendly and allow the user to speak to their device and get set up.

Other User Characteristics: This version of the software should be easy to use for individuals among all age groups and genders. By simply speaking to their device, the software will connect them to their requested user and present the environment that they desire.

Our first hands on users will be the employees from our initial business corporations that choose to use Virtual Room as a productivity enhancer. Our product should be catered to meet all the needs that a business has during a meeting, including the ability to present slideshows, virtual podiums and other mechanisms. Our second hands on users will be family members that are trying to communicate among each other over a large distance. Through this product, they maintain the sentimental relationships with their loved ones despite experiencing change throughout their life.

5d Maintenance Users and Service Technicians

Content

For this product we need to have a variety of maintenance users and service technicians for different parts of the product. The existing virtual reality renderer should be improved each year as the current technology improves. The UI of the application should also be updated yearly with new features added as new ideas are developed. The code should be refactored each year to handle new demands in traffic to the application.

Motivation

Through this analysis we realize that we need to hire skilled developers to maintain the legacy code because it will need improvements to avoid staying out-of-date. It will also need to handle a large amount of traffic effectively.

5e Other Stakeholders

Content

Other potential stakeholders in this process could be project managers from a variety of companies that would like to purchase the product.

Motivation

The motivation for many of these smaller companies will be if the benefits outweigh the overhead costs of the product. After seeing the productivity growth in larger companies, many of the smaller companies may be motivated to be involved in the process.

5f User Participation

Content

During the process, there will be a feedback section after each meeting that allows the user to address any concerns or issues they had during the virtual meeting. Through this feedback step, we are able to consistently improve our products and generate new ideas on a regular basis.

Motivation

The motivation behind this step benefits both the users and the developers. The users can address new features that they would like to have or issues that they are currently having. The developers can build an application that effectively scales to the needs of the consumers.

5g Priorities Assigned to Users

Content

Key users: Social Event User, Business Employees, CEOs

Secondary Users: Families

Unimportant Users: -

Motivation

The highest priority for this product is to provide a safe and interactive way for individuals to attend social gatherings while adhering to social distancing guidelines and staying safe. Another high priority for this project is to present an effective solution to virtual business meetings that preserves the sentimentality found in face-to-face conversations. The target users for our product will be business employees because we hope to improve productively and provide a better communication mechanism between the employees. Families will also be using this product but we will prioritize its use in a formal setting over the family setting.

6 Mandated Constraints

6a Solution Constraints

Virtual rooms help to provide the services with limited number of constraints for better usability for the customers.

Description: The virtual headset utilized by the user should have a Graphical Processing Unit (GPU) enabled with video decoding processes like Inverse Quantization.

Rationale: To enable a smooth animation and transition of virtual objects in the environment and to prevent latency in communications.

Fit Criterion: The user shall be able to enter the virtual environment with commercial VR headsets available in the market.

Description: The product utilized for communication needs to be lightweight.

Rationale: For long hour meetings, the headset and sensor gloves need to weigh less, and need to be ergonomic, such that it doesn't cause headache or muscle strains while wearing them.

Fit Criterion: The weight of the headset should be less than 510g to ensure that users can wear them comfortably for a long period of time without getting a headache.

Description: The mobile operating system should have an updated version of Android operating system.

Rationale: Earlier versions of Linux have deprecated methods and libraries which hinder with the working of the application. These methods become vulnerable to cyber attacks and might jeopardize confidential information.

Fit Criterion: Linux operating kernel of more than API 21 (Kitkat) is preferred for running the software on the mobile device.

6b Implementation Environment of the Current System

Content

Virtual rooms can be installed in mobile devices through the android operating system. The application will be supported for different versions of Android OS (minimum support API 21).

Examples

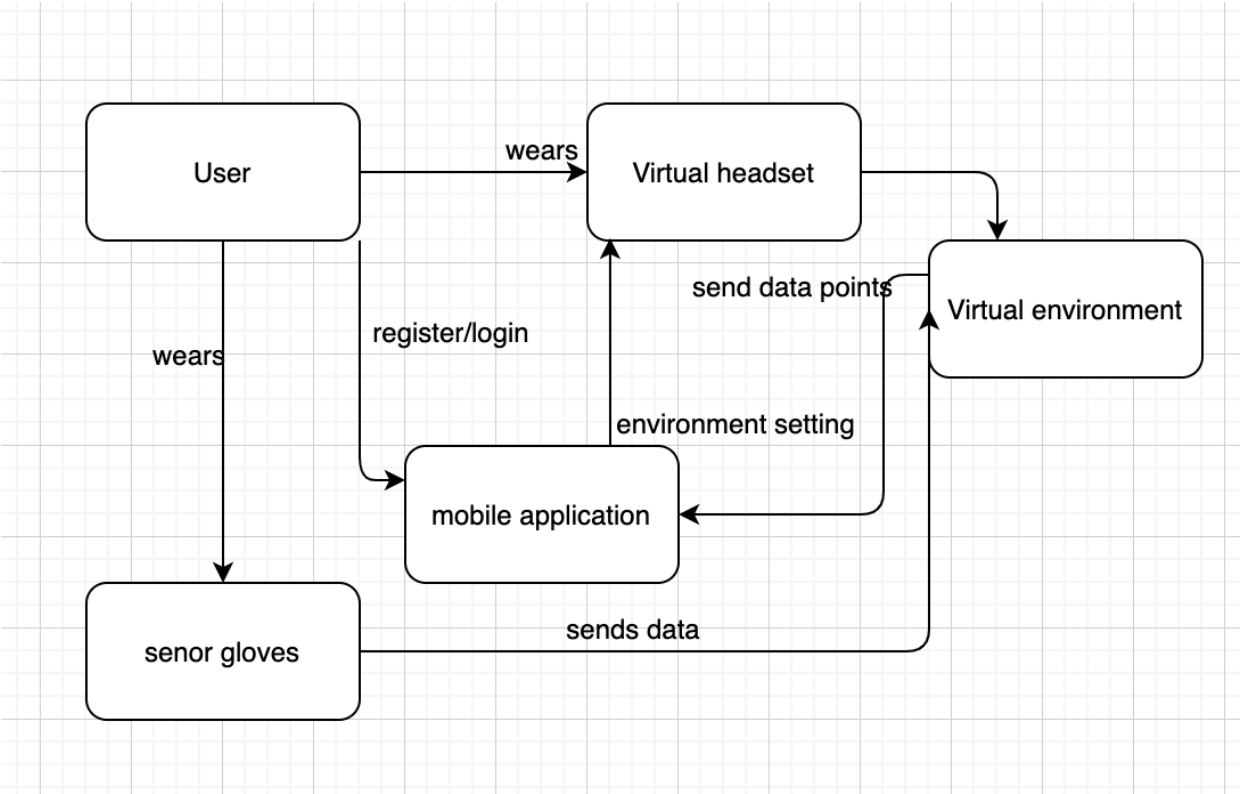


Fig 1.3: Implementation environment

6c Partner or Collaborative Applications

Content

Virtual rooms provide a smooth transition for the new users who initially register for the application. Users can utilize other social media platforms like Facebook, Twitch, hangouts, Google account, etc to register from their mobile application.

Motivation

With increase in internet application and diverse online platforms, users prefer to opt in new services with existing platforms. To include this functionality the architecture of Virtual room is designed to collaborate with other social media platforms and hardware configurations.

Examples

The mobile application will be implemented with a separate 2F authentication to ensure that there are no fake users or ID which are used to login inside the application. With integration with Facebook, many user accounts will be duplicate and fake. To tackle this problem, a unique token will be provided to users based on their mobile number as a mapping key which will help to ensure the credibility of the

user. In case the user loses his or her phone then proper recovery methods will be integrated inside the application.

The gloves sensors utilized for enabling tactile sensors can be enhanced by collaborating with companies like Omron. With advanced health monitoring devices, Virtual rooms will be able to keep track of the motion as well as vitals of the users to ensure what the user is touching and feeling while interacting with others. The data types recorded from the sensors can be altered based on the type of sensor involved.

For running the application smoothly without any interruptions, other applications in the mobile phone can be emptied from the application stack so that there are no notification and alert messages while running the application. Background and foreground services needed to be requested to pause while the application runs.

Consideration

The configuration for permission required might change depending on the type of company, such as Xiaomi, OnePlus, Windows phones etc, which run on Android operating systems. These exceptions are considered inside the Virtual rooms application for better scalability.

6d Off-the-Shelf Software

Content

Inclusion of some Off-the-Shelf software and hardware is required for facilitating smooth communication among users.

Motivation

The interfaces and design patterns of the virtual rooms are enhanced by inculcating software and hardware sensors to make the interaction realistic. Use of additional softwares which users find more convenient and are easy to integrate for the Virtual Rooms product.

Example

For the Virtual room software mobile application, the functionalities of the user interface and animating the video will be integrated using build-in drivers and Native SDK libraries of Android. The Camera Drivers of the C/C++ libraries will be utilized for faster processing of video and serialization of the video for network transmission.

To make the virtual environment realistic, the virtual headsets need efficient video decoding configurations. Various other headsets available in the market like Oculus, Microsoft, Unity etc can be utilized, depending on the software configuration of the product. The latest Oculus Quest 2 with a Snapdragon XR2 system-on-chip has the sufficient hardware configuration including the RAM, which supports the memory requirement for presentation of virtual face expression in a variety of softwares and games.

Additionally, as a part of the hardware need, senor gloves are worn by users to enable the tactile movements in the virtual setting.

6e Anticipated Workplace Environment

Content

The internal virtual environment of the Virtual room is selected by the user based on the theme and the type of meeting. On the other hand, the important aspects of using this product is the compatibility to use it in a variety of environments. Virtual rooms are compatible with environments which may include libraries, offices, home, trekking areas, conveyance vehicles like cars and busses, etc.

Motivation

For Virtual rooms to deliver the functionality based on the requirements of the users, the hardware and software need to comply with the environmental changes around. To make the accessible

Examples

For using a virtual room in quiet places, the virtual headset will have an inbuilt microphone and ear pieces which will help to listen to conversations privately without disturbing anyone else.

Since some products are not water resistant, getting in contact with water might make the display blur and cause the circuit boards to malfunction. Virtual room integrated powerful glues to join hardware components and rubber gaskets around the ports to ensure water doesn't damage the product. As a result, users can comfortably use the product in damp environments. For supporting noisy background, the earphones will be able to produce a vacuum so that the outside noises are blocked, and the user is able to hear the conversation of other participants in the virtual environment.

Consideration

For avoiding any hindrance in the work environment, the hardware and software of virtual rooms are tested as per the needs of the users. Different environments are taken into consideration prior to securing all the requirements needs of the users.

6f Schedule Constraints

Content

To meet the basic requirements and needs of different components of the product the different development releases must synchronize and work with other components of the system. Virtual Rooms is based on agile methodology to ensure an iterative increment of the product functionality.

Motivation

The virtual headset used for entering the virtual environment needs to be in sync with the latest updates of the mobile application being used. Failure in this requirement might induce some latency in processing the virtual expression and performing the required sentiment processing from the text.

Example

The user interface of the mobile application needs is completed incrementally in cycles of 2 to 3 week starting from the first week. The application will be segregated in components and prioritized based on the needs of the user. The virtual environment needs to be tested which has a deadline before the initiation date of the next cycle to verify whether it aligns with the requirements.

What would happen if the deadlines are not met or the incremental product is not built?

For the initial development of the product, the investment will be made on the software developers to develop the UI of the application and the hardware components. To meet with the losses of not meeting the deadline, the team will try to prioritise the functionality which will ensure the fulfillment of different requirements of the application. Due to extensive sales on the products on festivals, a marketing strategy will be adopted which will attract more and more customers to buy the product in the upcoming season.

6g Budget Constraints

Content

Virtual rooms will help to provide the required virtual environment by integrating the software and hardware.

Motivation

The different components required for the end product will be predicted to get an estimate whether it meets the requirement and meets the budget at the same time.

Consideration

For the hardware requirements, the virtual headset hardware will cost around $120 with the sensor gloves (including all the tactile sensors) around $50. The virtual headsets of different companies like Facebook, Samsung and Google are compatible with Virtual Rooms which can reduce the cost for users already having VR headsets. The mobile application will be readily available for free in the PlayStore with supported functionalities.

Is it realistic to build such a product?

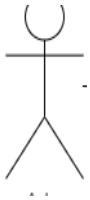
Virtual rooms aim at providing a realistic virtual environment by integrating existing technologies of Machine Learning and Virtual reality. As a result, it provides a totally different experience with enhancing the existing tools and the production cost can be kept in limit for the requirements to be fulfilled comprehensively.

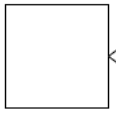
7 Naming Conventions and Definitions

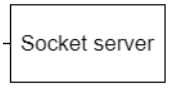
7a Definitions of Key Terms

- **Audience:** This can be a little vague depending on the context. For example, the host can also be an audience member, in family gatherings. But for like a sporting event the host does not have all the functionality that an audience member might have, and might have other administrative features.
- **Host:** Similar to audience, the term host might also be a little ambiguous, as for certain events the host might also want to be an audience member with special privileges, and in other cases the host might only be able to have an overview of what is going on in the room and is able create games and other events.
- **Room:** A room is simply the place where the specific event takes place in. For example a room could be a courtroom, or a stadium.
- **Activities:** An activity is anything that takes place within the room. For example games that were added to the room would be considered activities.
- **Oculus:** VR headset company created by Facebook, that allows developers to make games and other VR related products.
- **Event organizer:** An event organizer can be the host, admin, or even part of the audience. The main job of the event organizer is to manage all the activities, and the setting of the room. Including inviting the audience members. The event organizer is set by the admin or the host.
- **Admin:** The admin is appointed by the host and is able to oversee all parts of the event and can also be part of the audience. The admin can be the host, event organizer, and even the audience member.
- **Event organizer:** An event organizer is a term used to describe all parties that helped in organizing the event. An admin, host, event organizer are all considered event organizers.
- **Event:** An event can be used to describe a room, and can be used interchangeably.

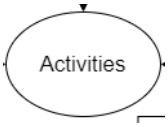
7b UML and Other Notation Used in This Document

-  This object represents an actor, specifically a user actor. This can be an admin, event organizer, etc. This object could also represent multiple audience members.

-  This object represents any sensor that the user has to use in order to make the VR work, or a sensor that will make the experience better. This object is only used in a single diagram.

- 

This object is used to represent any kind of server. In the scenario diagram this is used to represent a socket server that will be used to communicate with fast response times.

- 

This object is used to describe use cases in the case of the scenario diagram this object is used to represent an activity/activities.

7c Data Dictionary for Any Included Models

Since the majority of our data comes from a database, we will not need to utilize many different data structures other than Lists and Maps. Anytime the program needs to loop over data fetched from the database we will almost always use a list data structure since it is the best one to use when looping over data. Anytime we need to store data that has to be searched either now or in the future any Map data structure is the most suitable (HashMap, TreeMap, etc). Other than this, Virtual Room will most likely be relying on software like ElasticSearch or Algolia for full-text search.

8 Relevant Facts and Assumptions

8a Facts

Content

- This product needs to effectively implement a socket server to handle a high amount of traffic with minimal delay in sending and receiving packets of information.
- The primary objective will be to improve productivity in the workplace
- Almost all body language expression is lost with current communication mechanisms
- VR headsets have been used frequently but holographic projections are very infrequently used in current society

Motivation

The motivation behind all of these facts is the necessity for our product to be presented as an effective high-quality solution for the new era of communication. As there becomes an increased need for digital communication, we provide a unique solution to the everlasting problem.

8b Assumptions

Content

- Virtual Room is not reliable for any misuse of the product
- The holograph generator should be away from any liquids
- The holograph generator should be at least 3 feet away from any objects
- The holograph generator should be put in the middle of a room to generate an effective holographic display
- The Virtual Room is not responsible for any emergency calls or meetings with the local police department
- All meetings are immediately discarded unless the user has specified a cloud storage option to upload to

Motivation

Virtual Room intends to provide a safe and effective meeting platform. There are several safety precautions to follow when using the holographic generator. Virtual Room is not liable for any damages caused by misuse of the product.

Examples

Virtual Room is not intended for any lawful purpose and cannot be used in the courtroom as viable evidence.

The holographic generator needs to be in a location that avoids moist surroundings and has at least 3 feet of space away from other objects.

Our products are consistently being reengineered to improve with the current technologies.

The project will effectively manage a team of highly trained developers that carry out different aspects of the objective.

Considerations

These assumptions are intended to provide a safety net for the individuals involved in creating Virtual Rooms. These assumptions are also intended to protect the individuals that are using the product. Although there may be competing products that try to replicate our ideas, we will manage to outperform them through our efficient team and instilled values. Since we plan to work with a client that has experience in the technology industry, we hope to generate a very high quality product that meets all the needs of our consumers.

II Requirements

1 Product Use Cases

1a Use Case Diagrams

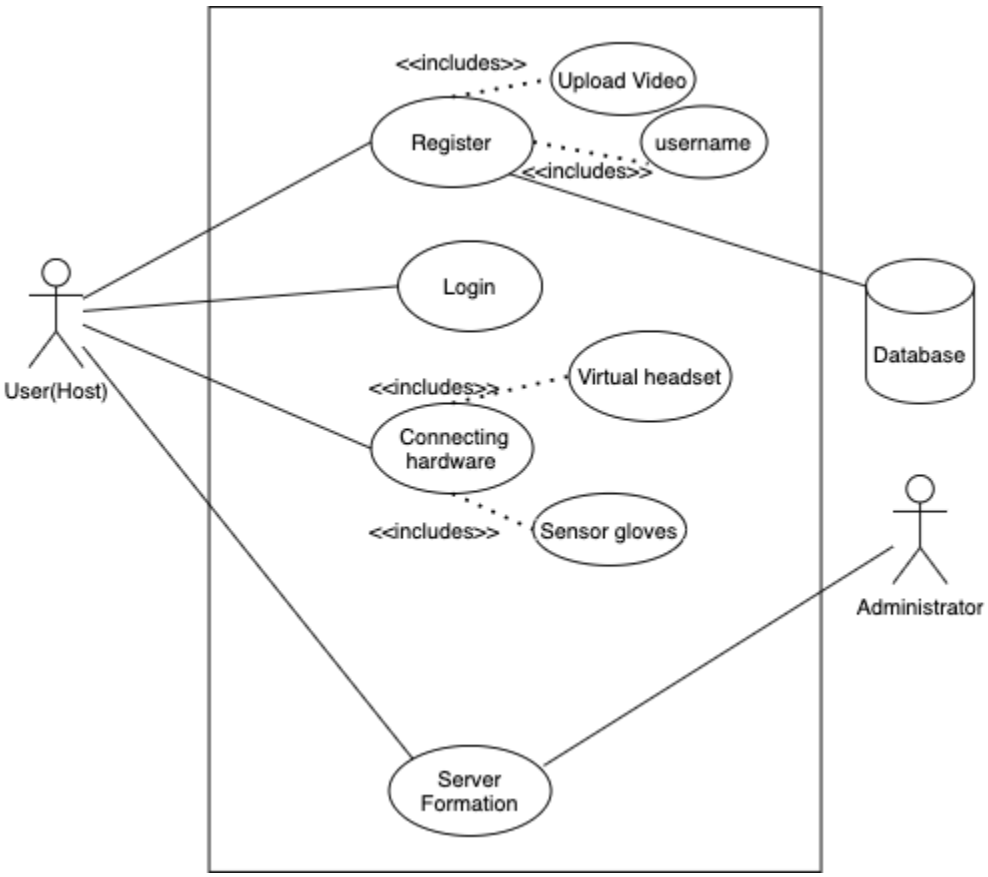


Fig 2.1 Virtual room use case external interaction

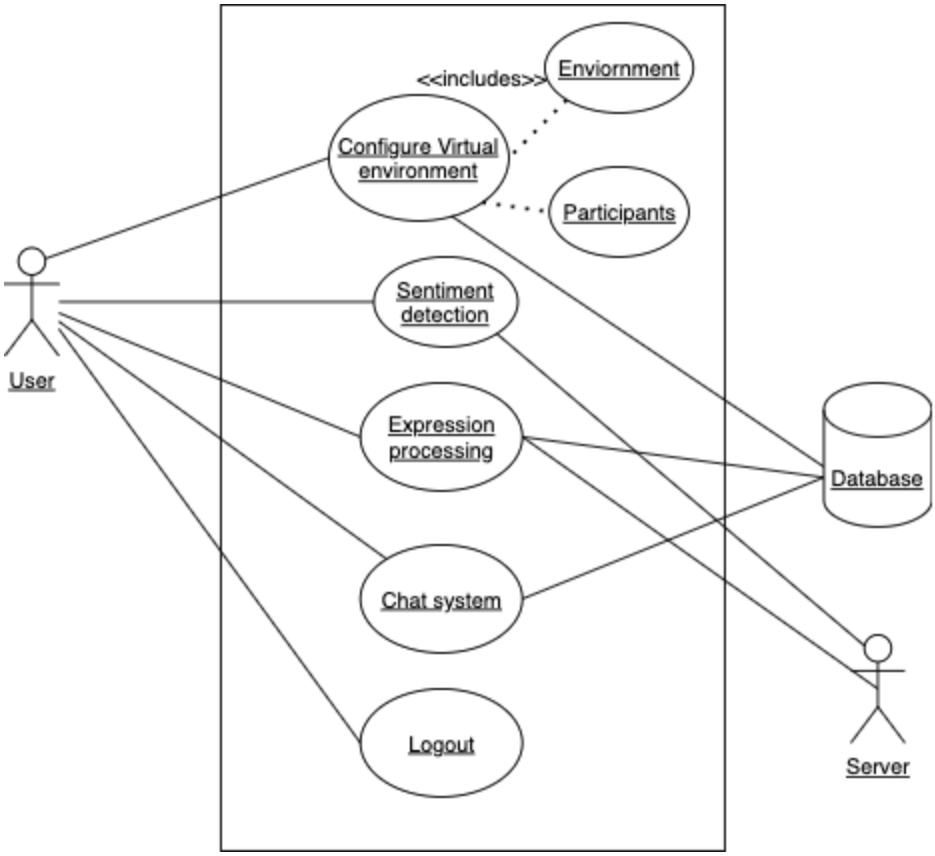


Fig 2.2 Virtual room use case internal interaction

1b Product Use Case List

Use case diagram 1 for virtual rooms describes the initial setup for initiating in Virtual room. The hardware configuration of the virtual headset and senor gloves need to be compatible with the software of mobile applications. Afterward the hardware configuration is satisfied, the server formation enables the user to invite other participants to form a virtual room for interacting with others. The user initiates the connection by forming a server connection from the mobile application. The Register component provides a vital threshold conditions for virtual rooms to process the virtual faces of users in the virtual environment.

Use case diagram 2 highlights the basic functionalities of the Virtual Rooms from the perspective of the user. The internal working of the application is divided in steps to provide a modular overview of the platform and the contribution of different actors in different use cases. The internal use cases like sentiment analyzer and chat system provide a medium for the user to exchange their ideas and express their emotions comprehensively. Configuration of the environment requires a server link generation which is unique to a particular environment and integrates sufficient authentication on users joining the sessions.

1c Individual Product Use Cases

Use case ID: 11 Name: Login pre-conditions: User must have registered in Virtual rooms post-conditions: User can access the resources adjacent to the account registered. Initiated by: User Triggering Event: Listeners on the mobile application Additional Actors: Database, Administrator
Sequence of Events: 1. The user enters the username and password entered at the time of registration. 2. The credentials of the users are sent to the server for authentication. 3. The user's video uploaded quality is checked and evaluated. 4. If the credentials are valid, the user is authorized to access the resources inside the application specific to their account.
Alternatives: If the user is not granted the login permission, they are redirected to the homepage for registering with the correct information. Exceptions: The video uploaded by the video needs to meet the quality conditions, else the user is not granted login access.

Use case ID: 12 Name: Connecting Hardware pre-conditions: User must have logged and completed the registration post-conditions: Successful interactions with the virtual environment Initiated by: User Triggering Event: virtual hardware configurations Additional Actors: Server
Sequence of Events: 1. The virtual headset and the sensor gloves bluetooth settings are switched on. 2. Mobile application pairs the devices to enable inputs in the environment. 3. Ear phones can be connected to the mobile phone to enable speech input.
Alternatives: The user is not able to connect the required input devices to the virtual environment. Exceptions: The version and hardware configuration might not be backward compatible with earlier versions of mobile software and hardware.

Use case ID: 13 Name: Sentiment Detection pre-conditions: The user must have set up the virtual environment and invited other participants. post-conditions: A comprehensive and meaningful interaction with the group. Initiated by: User(Host or participants) Triggering Event: virtual hardware configurations Additional Actors: Participants, Server, Database

Sequence of Events:

1. The user enters the virtual environment for interacting with other participants.
2. The microphone is connected to the mobile phone for speech input.
3. The speech is input is converted to text by API like Google speech to text.
4. The processed text is tokenized to make the processing faster.
5. The virtual face of the user is altered according to the report of the sentiments.
6. The restored data is stored in the database for further processing.

Alternatives: The sentiment detection produces little inaccuracy in the report.

Exceptions: Due to quality of the network, processing operations might produce some latency.

Use case ID: 17 Name: Chat system

pre-conditions: User setups the server and invites other participants for discussion.

post-conditions: Successful chatting room for group discussion.

Initiated by: User

Triggering Event: virtual hardware configurations

Additional Actors: Database, Administration

Sequence of Events:

1. The user(host) sends the invitation links to the other participants.
2. The participants open the menu for opening the chat window by clicking on the bar button.
3. Option for private message and group messages are displayed to the user.
4. Submit button can be used to send the message to the respective entity.
5. Other participants can participate in the chat with their ideas and thoughts.

Alternatives: The user joins the server afterwards and is unable to see the messages entered by other users in the group chat.

Exceptions: NA

Use case ID: 18 Name: Registration

pre-conditions: The user must have installed the mobile application.

post-conditions: The user is able to login successfully into the account registered.

Initiated by: User

Triggering Event: Graphical user interface interaction with the user.

Additional Actors: Server, Administrator, server

Sequence of Events:

1. The user inputs personal details like username, password, and full name.
2. The user is prompted to upload a video of 10 seconds to record the facial features and different edges of eyes, nose, forehead etc.
3. The video is sent to the administrator for authentication and verification.
4. After a successful verification the video is utilized and stirred in the database.
5. The users can login to the application after the registration is verified and successful.

Alternatives: The user registration fails and the user is not able to login into the application.

Exceptions: The video uploaded by the user does not comply with the requirement specified inside the application.

2 Functional Requirements

Content

Virtual rooms help to provide the users with an environment where they can interact with other participants efficiently. A list of functionalities are needed to achieve the main objective of virtual rooms.

Motivation

The platform provides the user with a simple and clear user interface for initiating the connection. Different hardware configurations for the virtual headset, sensor gloves and microphone is required to make the virtual interactions more meaningful. The mobile hardware permission is requested to enable the application to access the subsequent drivers like camera, microphone etc in the mobile phone. The data collected from the virtual setting is utilized to improve the subsequent expressions and communication of the particular user.

Fit Criterion

To provide the functionality to the user efficiently, some basic criteria are set to ensure the viability of the provided functionality. A rating system will be followed for

the subsequent communication to keep track of the quality of the services provided by the platform.

ID# 1 - Name: Processing data points

Description: Information like videos and user speech to be processed.

Rationale: The video is utilized to train the algorithms for changing user expression on the virtual face. The speech inputs are required for the sentiment analysis of the expressions.

Fit Criterion: The processed sentiment and expression must be presented in the virtual environment before the next expression is spoken. The time for processing should be within 1 sec.

Acceptance Tests: 1

ID# 2 - Name: System configuration

Description: Hardware connection with the virtual environment.

Rationale: With the availability of hardware and software devices, virtual rooms should be able to provide compatibility of software with different versions of devices.

Fit Criterion: Your fit criteria here . . .

Acceptance Tests: 9

ID# 3 - Name: Environment interactions

Description: Virtual Environment user interface for interactions.

Rationale: Depending on the type of discussion, the user must be able to select from the list of virtual environments type in the mobile application to start the virtual interaction with other people. The participants will be invited in that particular virtual setting.

Fit Criterion: Your fit criteria here . . .

Acceptance Tests: 7

ID# 4 - Name: Video permissions

Description: Permission for accessing the video functionality.

Rationale: The users are required to upload a 10 second video of their face (270 degree angle) as a part of the registration process. This video is processed and the virtual face of the participant is configured based on the data points in the video.

Fit Criterion: The virtual expressions are unequivocal for the other users to comprehend the expression of the user. The communication is done without any out of context misunderstanding.

Acceptance Tests: 2

3 Data Requirements

Content

Virtual rooms gather data from the users through hardware devices like virtual headset, sensor gloves and microphone and software like the mobile application and virtual environment setup.

Motivation

The data collected from the users is processed in the server to detect the sentiment of the user. The data points collected from the user are utilized to project a 3-D

Examples

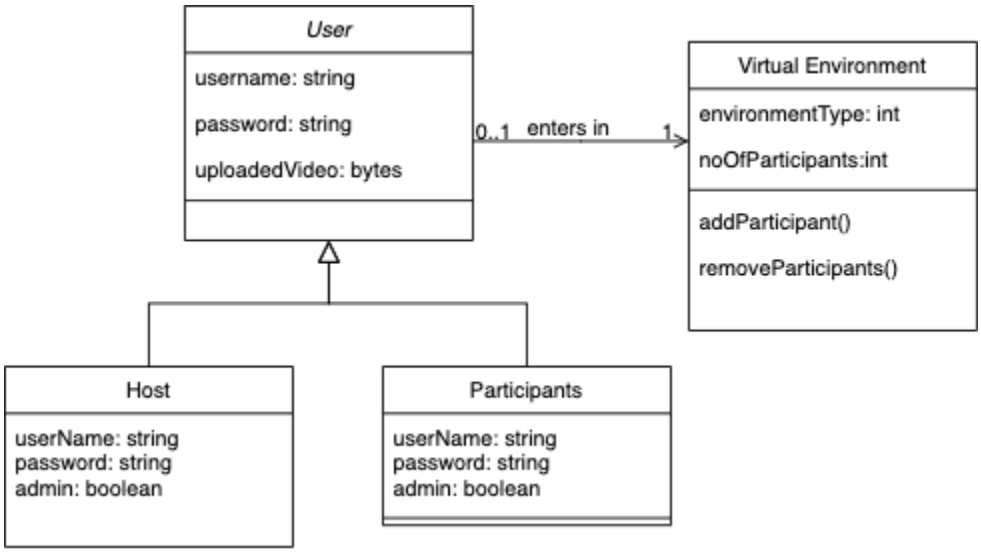


Fig 2.3: Data model for User interaction

ID: 5# - Name: Video upload

Description: The mobile application will collect the video from the users.

Rationale: The users are required to upload their video while registration. The video is processed in the server to change the virtual face of the user in the virtual environment. This will facilitate the communication between the other participants and the user.

Fit Criterion: The virtual environment will be able to change the face of the user on account of any emotion changes or conversation changes occurring in the environment.

Acceptance Tests: 2

ID# 6 - Name: Gesture detection

Description: The sensor gloves detect the movement of hands.

Rationale: The sensor gloves are equipped with tactile sensors to record the data pints of the users movement on the 3-D plane. The data extracted is in the form of coordinates of the cartesian plane to map the location in the virtual environment.

Fit Criterion: The hand gestures can help users to explain their viewpoints to the other participants more explicitly.

Acceptance Tests: 3

ID# 7 - Name: Microphone input

Description: Speech text from Microphone

Rationale: The speech of the user is recorded from the microphone or headphones to supply the supervised learning algorithms for sentiment analysis. The sentiment report is generated which is evaluated to determine the type of facial expressions on the user.

Fit Criterion: The virtual environment is able to present the virtual face of the user with the required expression without any latency.

Acceptance Tests: 9

4 Performance Requirements

4a Speed and Latency Requirements

Content

The virtual rooms require to process the data from the different participants of the users asynchronously while updating the virtual user interface in the virtual environment. Different metric criteria should be met to ensure that the communication is seamless and continuous between the participants.

Motivation

The users need to see the virtual expression of the user as soon as there is any context change in the virtual conversation. The expression must comply with the words

spoken and change the expression as soon as possible. A certain time frame is fixed which should complete the processing.

ID# 8- Name: Sentiment Analyzer latency

Description: The sentiment analyzer should process the text at a faster rate.

Rationale: The user should be able to detect the expression of others and change its or her own expression on account of any word spoken. The processing should be done within 1 second which will involve converting the speech into text and processing it into a learning algorithm.

Fit Criterion: There is no latency that detects the sentiment of the user.

Acceptance Tests: 4

ID# 9- Name: Component for video processing

Description: Video processing component.

Rationale: The video uploaded needs to be separated into different frames for pixel information of the frames into the expression module for training the SVM algorithm. The processing should be done within 10 seconds in the starting stages while showing a progress bar.

Fit Criterion: The virtual face of the user is able to highlight the expression of the user clearly with the context.

Acceptance Tests: 2

ID# 10 - Name: Concurrent processing

Description: Concurrency of multiple servers.

Rationale: Many servers will be running on the system which are initiated by multiple hosts. Different participants will join the meeting and should be able to communicate with each other smoothly without any latency. The virtual headset latency should be around 7-10 milliseconds.

Fit Criterion: No static interruptions in the speech of users.

Acceptance Tests: 5

4b Precision or Accuracy Requirements

Content

The accuracy of the data points collected from the hardware devices enables us to map the movements in the virtual environment which in turn provides the desired functionality with less errors.

Motivation

Virtual room relies on user input from a variety of hardware and software sources which need to be in compliance with the precision percentage. The type of data will include floating points numbers, textual descriptions, verbal speech, binary codes etc. and need to emulate the accuracy requirements for the better results.

Examples

Machine learning algorithms work on vectorized data from the dataset. Virtual rooms require the sentiment analyzer to work with accurate float value data points to establish accurate results with minimum error rate.

ID# 11 - Name: Pixel clarity

Description: Virtual face should be clearly visible.

Rationale: During the conversations, the virtual fave should present the expression derived from the processed video clearly to other users. The pixel density and the virtual headset should have the standard Graphical Processing unit to render the required frames from the video.

Fit Criterion: The pixels rendered are able to direct the sentiment of the user.

Acceptance Tests: 2

4c Capacity Requirements

Content

Virtual rooms provide the user with hardware support to provide the input for the virtual environment. The data accumulated from the devices is stirred in the database for further decision making. The database utilized will be NoSQL database for easy manipulation and editing of records.

Motivation

Large amounts of data will be gathered to provide a seamless connection between the participants. The initial version of the system will be targeted for a fixed amount of users to analyze the data volumes generated per user on a given time span.

Example

The type of data required to process the data depends on the component and input channels. For example the sentiment analyzer utilized data points in terms of double floating values to calibrate and compute a sentiment report of the user's emotions.

ID# 12 - Name: User session data

Description: Server accumumtad user data.

Rationale: Many participants will join one server connection. Each user will speak at an average of 5-6 sentences per minute depending on the various aspects like interest, whose turn to speak next etc. Approximately 2000 sentences are generated in 30 minutes, out of which siem are cached to improve performance.

Fit Criterion: Your fit criteria here . . .

Acceptance Tests: 1

ID# 13 - Name: Sentiment analyzer report

Description: A sentiment report for highlighting the result sentiment.

Rationale: The speech of the ruser is conveyed to text to token each sentence. The text vectorizer converts the word into integers which will be stored in the database for the vector algorithm to analyze. The data is in the form of a double floating point. Data set around 200 data points is sufficient for training the supervised algorithm.

Fit Criterion: The double float data is able to produce a detailed sentiment report.

Acceptance Tests: 1

5 Dependability Requirements

5a Reliability Requirements

Content

Virtual Room aims at providing a constant connection among people all round the world for uninterrupted exchange of information and ideas for group meetings. The system will be designed to stay online almost indefinitely. Ideally, Virtual Room will be able to limit the amount of time in updating its software and performing maintenance runs. To cater to this need, Virtual Room will periodically perform synchronous software updates by mapping the user's typical use time. These updates will complete without having to restart the software.

Motivation

It is important to maintain a smooth connection and objectify the possible areas of system failure which might contribute to the system crashing on the face of the user. These areas of failure might be introduced due to inconsistency in expectations of the different users and the variety of potential use cases for our product.

Examples

The severs should have the capacity to host a large number of meetings for 1 week at a time without needing to reboot. There should also be several backup servers for disaster recovery and allow concurrent maintenance of our application without having to start a maintenance break. No data should ever be lost for user accounts. Virtual Room does not store recordings of the meetings, and allows the user to store recordings locally on their drive before starting the meeting.

Considerations

This application is targeted on a global level. Due to this, we have to factor into account the variety of different time zones that the application could be used at. This system must be designed to withstand high volumes of users at any given time.

ID# 14 - Name: Stability of connection

Description: The system requires stable internet connectivity for the individual users interacting with the software online.

Rationale: Without stable connectivity between users, the application is unable to send the corresponding network packets and allow communication between the users. In this case our software will throw a network error message and require the user to connect to a suitable network before continuing.

Fit Criterion: This is required for any meetings that will be conducted non-locally among several users. If there is a local instance created among users that are in the same location, this requirement is relaxed. However, the users can only choose "virtual rooms" that are cached in our product's memory.

Acceptance Tests: 5

ID# 15 - Name: Login requirements

Description: The system requires each individual user to create a user account prior to starting a virtual meeting. This will allow the software to adequately calibrate a user's movements and features.

Rationale: In order to generate effective Machine Learning algorithms that accurately depict the movements of each user, the system needs to create a prototype of the user's current features. The virtualization generates holographic images based on the variability of the user's movements from that original prototype.

Fit Criterion: This is an effective strategy for all users because this induces the concept of our application. Real-time sentiment is preserved through the virtualization of the users.

Acceptance Tests: 4

ID# 16- Name: Dependability on hardware

Description: Hardware dependability

Rationale: The user needs to configure the hardware and sensor gloves with the mobile application. For example, for better compatibility of the virtual headset, aspects like optic quality, display resolution, display rate, and angle for field of view need to be sufficient for a virtual environment.

Fit Criterion: The virtual environment objects are changing with the same rate as the motions are performed in reality.

Acceptance Tests: 9

5b Availability Requirements

Content

Virtual Room is designed to be effective at almost all hours of the day. There will be scheduled times of maintenance once a month, where the system may be down for a maximum of 3-4 hours. Outside of this maintenance break, any patch fixes will be done on a weekly basis concurrently with the system operating.

Motivation

The driving force behind this concept is the idea that we want Virtual Room to provide a means of connecting people from different parts of the world in a collective room where they can interact as if they were together. In order to fulfill this demand, the downtime of our application has to be minimized because different parts of the world will have different times of use.

ID# 17 - Name: Maintenance schedule

Description: The system should always be running during normal business hours. If maintenance is needed, the systems administrator should schedule a planned update/break during the night and let all users several days in advance. These maintenance breaks should take no longer than 3-4 hours.

Rationale: The quality of this product is depicted by its availability of use. When doing any sort of maintenance or breaks, the users should be notified in advance so that it does not hinder any sort of plans.

Fit Criterion: These maintenance breaks will be very infrequent, and be used for patches for specific bugs and version updates to our software. At the end of each maintenance break, our product should be fully functional.

Acceptance Tests: 9

5c Robustness or Fault-Tolerance Requirements

Content

Virtual Room is designed to be used online. However, if there is no network connection, the application will allow basic holographic rendering and use of cached virtual rooms for local use.

Motivation

This product does not need to be fault-tolerant to network issues because the driving factor is to connect users around the world. Local use is not our targeted scope, but we will still provide minimal functionality for it.

ID# 18 - Name: Fault tolerance

Description: The system is still able to project virtual rooms when the user is offline and cannot be detected by the network. These virtual rooms are loaded from the device's cache.

Rationale: Virtual Room should still maintain minimal functionality of projecting environments through holographs for the users. Although it won't be able to obtain any new environments from the network, it should at least contain the recent or preliminary environments.

Fit Criterion: There will be occasions where everyone that needs to work together is already present. The Virtual Room application can be used to project different sceneries to change the feel of the environment for the users.

Acceptance Tests: List ID# and/or names here . . .

5d Safety-Critical Requirements

Content

This product abides by the general safety requirements that other electronic devices have. Likelihood of damage to person, property and environment are minimal, however there are still warnings for liquids and heat for preventative measures.

Motivation

Virtual Room needs to provide these basic preventative measures to protect the individuals that could be held liable for any actions of the consumers.

ID# 19- Name: Critical conditions

Description: This application should have several warnings regarding exposure to liquid or heat for the headset and holographic generator. If tampered with, they can cause very dangerous consequences resulting in fire or bodily harm.

Rationale: This product is designed to be in a room-temperature environment with no exposure to liquids. The designers and the manufacturers are not at risk if the user does not abide by the warnings.

Fit Criterion: Any types of mistreatment to the product will have unseen repercussions that cannot be determined by the manufacturer.

Acceptance Tests: 8

6 Maintainability and Supportability Requirements

6a Maintenance Requirements

Content

Maintenance requirements are one of the highest priorities for our product. The value of our product is derived from the use over time and popularity among individuals of a variety of countries. To provide a high value to our consumer, we set several maintenance standards to consistently verify that everything is working in the best condition possible.

Motivation

Our consumers idealize a reliable product that works effectively regardless of your location, as long as you have a stable internet connection. To make this consistently possible, several operational measures must be taken each week to maintain inflow of traffic.

Examples

System must be able to maintain interglobal business meetings between users in Japan and America where there is a 10 hour time gap.

Considerations

Although it is impossible to be completely fail-proof, our system administrators will allocate the proper preventative measures to maintain our software as effectively as possible under an influx of conditions.

ID# 20 - Name: Updation requirements

Description: Client-Server allocation modified weekly dependant on new demand of users in regions.

Rationale: Our product will vary in popularity among regions at different times. It is imperative that we modify the influx of users per server based on the traffic during that time.

Fit Criterion: This must effectively improve performance for users on a weekly basis if they are in a region with high product use. If demand reaches a point where performance is steadily declining, more hardware must be purchased to meet that demand.

Acceptance Tests: 5 .

ID# 21- Name: Update policy

Description: Patches released weekly with a concurrent software update to maintain users during the process. These patches are determined by new complaints and feedback from users during their meetings. Depending on severity, there may be more than one patch during a week.

Rationale: Our product should be adaptable and manage to effectively deal with bugs in a systematic manner that does not require our systems to go down. To perform these consistent patches, we sequentially reboot all our servers by temporarily changing traffic inflow.

Fit Criterion: This product is expected to operate in environments where there may be several bugs that the team is working on. However, with the current methodology, any bug should be minimized to the point where our application still works for our users. If there is anything that limits certain users, the issue should be taken care of immediately in the next patch.

Acceptance Tests: 4

6b Supportability Requirements

Content

The software for this application should be available on both the Google Play and Apple Store. Support for this application should be maintained through a help desk to aid customers and businesses to set it up properly and maximize the value. The help desk is available at any point as long as the product owner can be verified.

Motivation

The system should be available for any user with a smartphone and the Virtual Room product. The user has made a life-long purchase with support for our product.

Considerations

The system will have an AI for basic support in issues that can be resolved without expending human capital. After the user has insisted in human support, there will be a support team in English available to assist the user.

ID# 22 - Name: Supportability of Virtual rooms

Description: Help Desk Support

Rationale: Users may have technical difficulties in operating our product. To provide the maximum benefit for our end-users, we will have a help desk operational during certain hours of the day/night to assist.

Fit Criterion: This product will have a variety of AI support features and videos demonstrating use. However, it will still be expected to have a high inflow of calls during initial release for each region.

Acceptance Tests: N/A

6c Adaptability Requirements

Content

Our product is not expected to be ported on other platforms. With a Virtual Box purchase, the user obtains a headset, holographic simulator, and software for mobile.

Motivation

Our product is expected to be differentiable from other products on the market because of our additional features that were never previously implemented. Through this, we can seclude our niche market and maintain full market power.

ID# - Name - N/A

6d Scalability or Extensibility Requirements

Content

Scalability is a major priority for our system. Since it is targeting a global market in a variety of countries, we expect inflow of traffic to be exponential over time. To manage these high scalability requirements, we make new geographic decisions on destinations for our servers. Our systems administrators may purchase cloud servers from Amazon or Google if we cannot meet the demands of our consumers.

Motivation

Ideally we would like to scale consistently to demand and make appropriate purchases as needed. It is necessary to always air on the side of caution.

Examples

Our product is becoming popular in Japan and the US. From there commerce and business between Japan, India, and China potentially changes with the introduction of our product. Now the US is also using our product with India, China, and also Canada. In this scenario, our branching factor is 3 and our product grows in popularity at a rate of 3^t where t denotes an arbitrary time interval from the launch of

our product. Due to these potential scaling factors, our systems managers should purchase servers as needed on a bi-weekly basis.

ID# 23 - Name: Geographic scalability

Description: Data Centers in at least 3 separate regions at launch

Rationale: Through this requirement, we initially obtain segregation of demand from users. Each region can manage its own users and connect to the other regions through our VPN. System administrators can manage workload as needed.

Fit Criterion: Our product should be able to adapt with an influx from 10,000 users to 100,000 users within the span of 3 weeks .

Acceptance Tests: 5

6e Longevity Requirements

Content

This product is expected to last several decades. It may have several legacy products if successful.

Motivation

To create and implement this product, a large amount of resources are required. In order for the business costs of production and maintenance to be worthwhile, this product must stay in the market for several decades.

Examples

This product is expected to become profitable for the business by year 5. Subsequently, the next several years should be invested into improving the quality to provide a longer lifespan in the market. By year 10 the product must start operating within the maximum maintenance budget.

ID# 24 - Name: Revenue prediction

Description: Generate more revenue than costs by year 5, improve quality till year 10, and then start making a profit for the next several decades.

Rationale: On initial release, the product will incur very high fixed costs. Over time, those fixed costs will diminish in relationship the variable costs of maintenance and continuous improvement.

Fit Criterion: This product should last a minimum of 20 years.

Acceptance Tests: NA

7 Security Requirements

7a Access Requirements

Content

The virtual room application can only be accessed by authenticated users. The application itself can be opened without logging in, however once logged in, users will have to sign in with their virtual room email address and password. The user will also have the option to authenticate via touchID or faceID.

Motivation

To protect users from unauthorized access of their virtual room and their virtual room contacts.

Examples

Only the individual user of the virtual room account has access to their virtual room and contacts. If they forget their password, we can send a link to their email address to reset the password.

Fit Criterion

For personal accounts, only the individual user has access to their data. For business and organizational accounts, the data access level is broadened to managers and can be adjusted by the organization.

Considerations

For business and organizational use, the virtual room accounts for that organization can be adjusted such that the manager of a group has access to the virtual room events, those events can be recorded, as well as the data within. This is an option only available when the accounts are signed up specifically for the business / organization. Otherwise, every individual account is the only one who has access to their data. This is for privacy and security considerations.

ID# 25 - Name: Credential requirements

Description: The virtual room application can only be accessed via the user's email address and password

Rationale: To protect users from unauthorized access of their virtual room and their virtual room contacts

Fit Criterion: For personal accounts, only the individual user has access to their data. For business and organizational accounts, the data access level is broadened to managers and can be adjusted by the organization.

Acceptance Tests: 1.

7b Integrity Requirements

Content

The databases for users can only be unlocked via their email and password. For the organizations, the authorization of the appropriate managers is required.

Motivation

To prevent individual users, as well as organizations data from being accessed without authorization.

Examples

The product shall protect itself from intentional abuse.

Considerations

The database itself will be encrypted by the user email addresses and passwords. Beyond that, it will be hosted via the cloud for security, reliability and integrity. Amazon and Microsoft for example both have industry leading platforms for cloud based data server hosting in AWS and Azure. We could use one of these platforms to insure the integrity of our customers data.

ID# 26- Name: Security considerations

Description: The databases for users can only be unlocked via their email and password. For the organizations, the authorization of the appropriate managers is required. The database will be encrypted by the user email addresses and passwords. As for hosting the data, our preferred choice would be within the cloud. Choosing Amazon Web Services or Microsoft Azure as our platform will insure the integrity of our customers data.

Rationale: To prevent individual users, as well as organizations data from being accessed without authorization.

Fit Criterion: Clearance only to individual owners of accounts. For businesses clearance can be at a managerial level.

Acceptance Tests: 4

7c Privacy Requirements

Content

Our security and privacy go hand in hand. As the data is encrypted via the user email addresses and passwords, we ensure that the user's data is only accessible by the user

themself. The only exception is for the accounts that are made specifically for businesses. Those accounts are managed by the organization.

Motivation

To ensure that Virtual Room compiles with the law and to protect the individual privacy of our customers.

Examples

Virtual Room will inform the customers about the privacy policy when they download the app.

Considerations

For our customers that are organizations and businesses, they will have their own legal standards that they must comply with. For example, HIPPA for medical practices. As the data will only be accessible to those users among the organization that have the appropriate approval, virtual rooms will be complying with those standards.

ID# 27- Name: Data hiding requirements

Description: Our security and privacy go hand in hand. As the data is encrypted via the user email addresses and passwords, we ensure that the user's data is only accessible by the user themself. The only exception is for the accounts that are made specifically for businesses. Those accounts are managed by the organization.

Rationale: To ensure that Virtual Room compiles with the law and to protect the individual privacy of our customers.

Fit Criterion: Clearance only to individual owners of accounts. For businesses clearance can be at a managerial level.

Acceptance Tests: 1

7d Audit Requirements

Content

Audit requirements are a vital part of the system configuration that deal with financial components. But Virtual rooms have no financial or medical systems as part of the services offered. As such, there will be no audit requirements from any side of the model.

ID# - Name - NA

7e Immunity Requirements

Content

Virtual room will have an extensive cyber security team to prevent any trojan horses, viruses or worms from entering the mobile application and the server which are utilized for official meetings..

Motivation

Virtual rooms provide a means of sharing Confidential information through its platform. As a result, a system protected with appropriate technologies is a compulsion to ensure privacy and integrity of user's data.

Considerations

We must be careful of new viruses and injection attacks into software, the cybersecurity team will be responsible to defend the software from these attacks.

ID# 28 - Name: Security policies

Description: Virtual room will have an extensive cyber security team to prevent any trojan horses, viruses or worms from entering the app. Having employees actively combat these viruses and attacks is the best option to defend the software from such malevolence.

Rationale: To protect the user's privacy, as well as the integrity of the app itself (as well as the company which developed the app, aka us)

Fit Criterion: The cybersecurity team will need to be assembled carefully and with experts in the mix as security is a huge part of any trustable application.

Acceptance Tests: 1

8 Usability and Humanity Requirements

8a Ease of Use Requirements

ID# 29 - Name: Usability requirements

Description: Virtual Room is optimized for both expert users and novice users so that users with different levels of proficiency can use the system at their own pace.

Rationale: All users, on their initial use are given hints and useful tips to make the experience smooth, and as the user uses the system more the software starts letting the user take more control. This is done via an AI that can adjust on the fly, and adapt to the users' needs when the user seems to be troubled, since certain rooms can get extremely busy and overwhelm users.

Fit Criterion: Other than implementing a proper AI and help banners, etc. In order to successfully implement such a system we will also need to ensure all rooms have guidelines to help out guests so they can navigate with minimal issues.

Acceptance Tests: 6

8b Personalization and Internationalization Requirements

ID# 30 - Name: Language requirements

Description: Since Virtual Room was designed to be accessible to a wide range of users, the system supports multiple languages, and even live caption to help users interpret other users that may not speak the same language, or have trouble listening.

Rationale: Virtual Room supports multiple languages in order to navigate the software, so that we cover a wide range of users. In addition to this, Virtual Room also allows users to use the "Live Caption" feature that uses AI to help interpret users that don't speak the same language.

Fit Criterion: Since language interpretation can be extremely difficult, the system will need to have a lot of data for the AI models, such that the live caption feature works as intended, with minimal errors/mistakes. Users will also have to be mindful, since Live Capture isn't a human interpreter, so mistakes are easily possible, as languages can be very expressive and the software might not be able to express certain phrases, jokes, etc.

Acceptance Tests: 7

ID# 31 - Name: User interface requirements

Description: Virtual Room gives the users a lot of power to customize their experience so that they are in control of how they want certain elements, characters to look and interact.

Rationale: Virtual Room is highly customizable and comes with many preconfigured configurations that the user is able pick and choose from. However, for users that want further customization, they can achieve this by manually customizing the elements, designs that they want changed for themselves, using user-friendly tools.

Fit Criterion: For the users to create custom skins and designs it will be necessary to have a very interactive interface for the UI so that any user that has access, can change things up with minimal effort and without the need to have any coding or 3-D modelling/designing experience.

Acceptance Tests: 6

8c Learning Requirements

ID# 32 - Name: Walkthrough of product

Description: Setting up all the sensors can be done with relative ease, as the product comes with a user manual that walks the user through everything necessary to have a proper, and working Virtual Room experience.

Rationale: The headset and sensors are designed to be easily connected. However, for users that do have trouble, the product also comes with links to tutorials that help with the setup. In addition to that, users can also get assistance to help them get the correct setup.

Fit Criterion: For the users to have an easy time setting up the system, it is necessary that our manuals readable, and provide details where necessary. User tests will also have to be done such that we understand what specific areas users have trouble with.

Acceptance Tests: 4

8d Understandability and Politeness Requirements

ID# 33 - Name: Feedback requirement

Description: The system makes sure to give the user proper feedback when the AI determines is right for the user. The software makes use of banners that are easy to read and allows the user to close these prompts.

Rationale: Virtual Room makes sure to give users feedback if a certain feature isn't available, for example. These banners that display warnings or errors must have different visual queues to show the user the severity of the feedback.

Fit Criterion: Banners that aren't extremely important have to be implemented in a way that they don't distract the user too much but at the same time, banners that are important and the user must attend to them as soon as possible, must stand out, with really important banners that block all other processes.

Acceptance Tests: 6

8e Accessibility Requirements

ID# 34 - Name: Interaction of users

Description: For people with physical disabilities that involve movement, Virtual Room offers many ways to interact with the virtual environment, without giving up major features that alter the experience in a negative manner.

Rationale: Since Virtual Room's primary input and output sensor is the VR headset, users are able to simply be seated and interact with the virtual world. So

for users that can't stand or move normally, they can simply choose to sit on a chair with wheels and swivel motion in order to easily interact with the room. In addition to this, Virtual Room also allows for users to purchase specialty products with addons that allow for specific features, like a controller to move around with, for users that are unable to walk properly. Virtual Room also uses many sensors that track facial expressions, and track skin movement on the user, which can help users that lack the ability to use any physical movement to also interact within the room.

Fit Criterion: In order for these functions to be fulfilled properly, Virtual Room needs to ensure that all onboard sensors need to be fully functional. With regards to specific sensors and controllers, the user will have to purchase these addons/sensors separately.

Acceptance Tests: 6

8f User Documentation Requirements

ID# 35 - Name: Documentation requirement

Description: User manuals that are shipped with the hardware provides all essentials to get started with using Virtual Room. Upon first boot the software will also give the user an option to watch videos and tutorials to get used to the software.

Rationale: Due the nature of virtual rooms users can get confused and overwhelmed and unable to use the product properly, which is why the software has an easily accessible help button that gives them the ability to quickly find resources that they need.

Fit Criterion: In order to improve user experience, tutorials and manuals must be easy to watch/read. The quick help feature must also be implemented to have an easy search so that the user can find the help that they need without having to be too specific.

Acceptance Tests: 6

8g Training Requirements

ID# 36- Name: user trainings requirement

Description: There should be no need for users to go through a special training program in order to use the service. If the user needs special help, then there is a way to contact/chat with the Virtual Room support team that can help the user sort out the issues that they face.

Rationale: The provided manuals, tutorials, and help pages must be enough for the vast majority of the user base. But for the small percentage of the user base

that does need extra help in order to get started, or resolve issues, the help desk feature should be enough for this case.

Fit Criterion: In order to make sure that the users don't have to go through the hassle to talk with the support, we will have to make sure that the manuals and tutorials all have common and uncommon errors or issues that the user might face. With tutorials geared towards expert and novice users so that users can get up to speed with minimal time wasted. To make sure users get the best help with the help desk feature any time they start a support ticket they should be provided with tutorials that they can use, in case the user hasn't already tried to resolve the issue via the tutorials and help pages.

Acceptance Tests: NA

9 Look and Feel Requirements

9a Appearance Requirements

ID# 37 - Name: User interface

Description: The color schemes that the interface will be completely dependent on the users preference, with pre-configured colors that range with bright to bold, and high-contrast colors.

Rationale: Instead of making one uniform color scheme for all users, we want individual users choose the colors they would like to use so that they make the spaces their own. This also gives users a sense of ownership, like how they would in their own room.

Fit Criterion: Even though we give the users the ability to choose or create their own palette, our system has to make sure that these colors also go with other elements and don't clash with logos, etc. So to ensure this, we will have certain guidelines and certain colors might not be allowed due to clashing with elements that might have clashing colors.

Acceptance Tests: 6

9b Style Requirements

ID# 38 - Name: Style of UI requirement

Description: Virtual Room will have a consistent style throughout the interface that will help the user to navigate efficiently.

Rationale: To create a good UI it is important to make users use recognition and recall so that even when different color schemes are used the user still understands the basic layout to navigate through menus etc. And since there can be many variations of colors we will need to make sure users are able to navigate with ease.

Fit Criterion: In order to make users use recognitions our UI will need to use icons that are universally accepted so that the users can understand what a button is intended to do without the need to see the actual text. Buttons and design elements must also do exactly what the label or icons says it should do and nothing more in order to avoid confusion.

Acceptance Tests: 6

10 Operational and Environmental Requirements

10a Expected Physical Environment

Content

Virtual room utilizes a combination of hardware and software to provide a seamless connection among the users. These hardware are easily accessible and provided by different vendors which will be compatible with the mobile application.

Motivation

The virtual headset provides a virtual setting for the user to interact with the virtual environment and operate their real movement.

ID# 39 - Environment policies

Description: Avoiding raining conditions

Rationale: The sensor gloves used to control the gestures in the virtual environment will be incorporated with tactile sensors to detect the coordinates of the hands. These sensors will be surface sensitive which might interfere with the readings taken to detect the movement.

Fit Criterion: The data collected is accurate and provides the desired outcome in the virtual environment.

Acceptance Tests: 6

ID#40 - Voice requirements

Description: Noisy environment

Rationale: The microphone is connected to the mobile application through bluetooth or NFC which will record the speech. To detect the voice clearly, certain functions will be implemented to filter the noise from the environment but some sounds might interfere with speech to the text module of the system.

Fit Criterion: The text return from speech produces an accurate sentiment report of the user.

Acceptance Tests: 8

10b Requirements for Interfacing with Adjacent Systems

Content

The hardware requirements need to comply with the configuration requirements of the other components to successfully deliver the functionality.

Motivation

With different versions of software backward compatibility of the devices is required. Virtual rooms make sures to cover the edge cases failure which might arise due to inconsistency in hardware versions.

ID#41 - Hardware policies

Description: Hardware configuration

Rationale: With the availability of different hardware components Virtual rooms should be able to provide the support for various other hardware devices like Oculus virtual headset to deliver the same functionality.

Fit Criterion: Connectivity with the other hardware devices through wireless communications like bluetooth, NFC etc.

Acceptance Tests: 9

10c Productization Requirements

Content

For the mobile application, the app will be distributed via the Apple app store, Google app store, and Microsoft app store. If any other mobile phone app stores are added later on, then the app can be distributed on those as well. However, that would be after making sure that the security of those app stores is reliable. As for the desktop application, the app will be distributed via our website.

Motivation

To ensure the accessibility of the application from all platforms.

Examples

The app will be distributed from the mobile application stores in whichever formats those app stores prefer. For the desktop applications, they will be distributed in exe files, with different installers for windows and mac.

Considerations

Although the application itself can be downloaded easily, to access an account and actually use the application one must sign in either via their own personal account or with an account registered via an organization.

ID# 42 - Name: Compatibility requirement

Description: The application will be distributed in the Apple app store, Google app store, and Microsoft App store. The desktop version will be distributed via our website.

Rationale: To ensure the accessibility of the application from all platforms.

Fit Criterion: Ease of access for users.

Acceptance Tests: 7 and 4

10d Release Requirements

Content

The release cycle is intended to be on all platforms at the same time. The product itself shall be updated regularly according to the industry standard.

Motivation

To keep the application up to date for security purposes, as well as bug fixes and overall performance.

Examples

The updates will be available via the app store and our website (desktop version).

Fit Criterion

The software engineers on the team will be tasked with keeping the app up to date.

Considerations

Not having too many updates back to back, as not all users have automatic updates enabled, and not everyone likes to have to constantly update their application.

ID#43 - Name: releasing requirement of virtual rooms

Description: Releases will occur regularly, at least once a week.

Rationale: To keep the application up to date, free of bugs, and secure.

Fit Criterion: All software engineers will be tasked with keeping the application up to date.

Acceptance Tests: 7 and 4

11 Cultural and Political Requirements

11a Cultural Requirements

Content

Sociological factors influence the requirement specification of the system and Virtual rooms considers the various cultural aspects to address the needs of the users.

Motivation

It is important to have a comprehensive perspective on the way the users see the product. Solely relying on developers for ensuring the compatibility of the system actress different countries and societies is not justified.

ID# 44- Language constraints

Description: Language constraints are imposed on the system.

Rationale: Initiality the first release of the product will provide the functionality to a smaller section of the people for gaining some feedback on the usability of the product. It will restrict to the United States and European countries with few cultural differences.

Fit Criterion: The users are able to understand the product and don't find any information offensive to their religion.

Acceptance Tests: 7

11b Political Requirements

ID# 45 - Name

Description: Virtual rooms comply with the political aspects of the areas.

Rationale: Different countries have different laws which apply to the software products launched.For example the advertisement policies might restrict the application from displaying content that might be politically biased towards a political party's votes.

Fit Criterion: The clearance of all the policies of the regional area.

Acceptance Tests: 9

12 Legal Requirements

12a Compliance Requirements

Content

Virtual Room has several legal compliance requirements that it must abide by. The first is the International Age Rating Coalition(IARC) where the application is expected to be 12+. Another legal requirement is copyright protection for any audio or video shared by participants in the room.

Motivation

This will protect the makers of Virtual Room from any sort of lawsuits or legal fees.

Examples

Song name and artist is presented during the Superbowl.

Fit Criterion

Virtual Room should comply with the majority of countries laws and regulations.

Considerations

Once the product has scaled by a large margin, a lawyer may need to be consulted for any new legal implications our product may have.

ID#46 - Name: Compliance with age groups

Description: Compliance with International Age Rating Coalition(IARC)

Rationale: One our product is in compliance with IARC, we can launch our application in a multitude of different regions.

Fit Criterion: Minimally should work with the US, Europe and Canada.

Acceptance Tests: 7

ID# 47 - Name: Infringement rights

Description: Audio/Video Copyright Infringement

Rationale: Our product should be protected from any lawsuit involving audio or video played by any consumer.

Fit Criterion: Applies to any and all meetings performed through Virtual Room

Acceptance Tests: 8

12b Standards Requirements

Content

Our product must conform to the specifications of our users. In the legal setting, we should launch an alternative branch of our software to comply with all legal requirements of the Country/State.

Motivation

Virtual Room can have a variety of uses. Based on the ones that become popular, the administrators can adjust legal compliance accordingly.

Example

Virtual Room does not become popular among courts, but rather in social gatherings. Now the product can be tailored to have more relaxed standard requirements.

Considerations

Alternative branching may be necessary to comply with all standards. For example, a child product named Virtual Courtroom is used in the court setting.

ID# 48 - Name: Modification based on popularity

Description: Scope Modification Based On Data Of Popularity

Rationale: Our product should excel in the niche market it may end up in, despite being unexpected.

Fit Criterion: After the 3rd month, user data is analyzed to determine which types of users are most likely to use our product.

Acceptance Tests: 4 .

13 Requirements Acceptance Tests

13a Requirements – Test Correspondence Summary

Requirements ®

Test	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	R 12	R 13	R 14	R 15	R 16	R 17	R 18
Test1									X									
Test2	X								X						X			
Test3					X													
Test4			X				X						X			X		X
Test5										X								
Test6		X														X		
Test7			X															
Test8											X							
Test9						X											X	

Table 1 - Requirements - Acceptance Tests Correspondence

13b Acceptance Test Descriptions

ID # 1- Name: Data integrity

Description: Testing the input format from hardware and software through casting and conversion.

ID # 2- Name: Video density

Description: Testing the video resolution for highlighting distorted frames and blurred pixels for images.

ID # 3- Tactile sensor accuracy

Description: Test for data points for accuracy of the mapped points in the virtual environment in Virtual rooms.

ID # 4- Name: Critical test

Description: Critical test cases to break the system using unexpected and foreign data.

ID # 5- Name: concurrency test

Description: Testing the system for Concurrent execution of system on multiple server using concurrency models.

ID # 6- Name: feedback testing

Description: Feedback testing to ensure the compatibility of the product across different cultures and geographic locations.

ID # 7 - Environment

Description: make sure the environment in which the user is attempting to use the virtual room is suitable, not rainy, etc.

ID #8 - Voice

Description: make sure the voice is audible using the virtual room application. Check to remove visual background noise as well.

ID #9 - Hardware

Description: Do an overarching test of the various hardware components within the virtual room setup and make sure everything is working.

III Design

1 Design Goals

The Virtual Room project should be optimized to have an interface of type Virtual Room. As technologies and underlying hardware develop over time, we create new subclasses that inherit this interface and provide the same functionality while adhering to different characteristics. The initial design should have sub-classes of type Virtual Room Headset and Virtual Room Projector. With this design implementation, as we develop new methods of communication, we can take advantage of new technologies available in society.

2 Current System Design

Not Applicable

3 Proposed System Design

3a Initial System Analysis and Class Identification

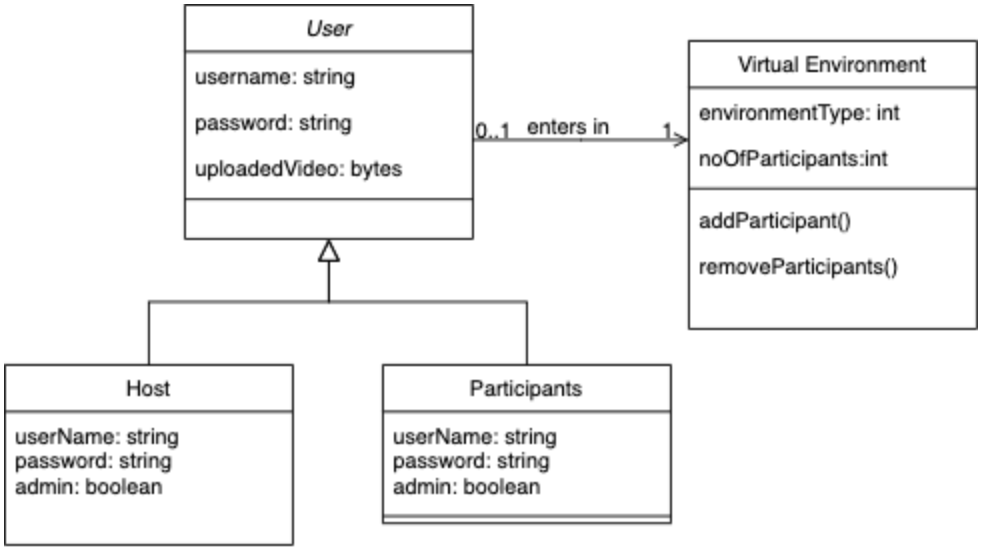


Fig 2.4 Class Diagram for subsystems

3b Dynamic Modelling of Use-Cases

Sequence diagrams for the virtual rooms are as follows:

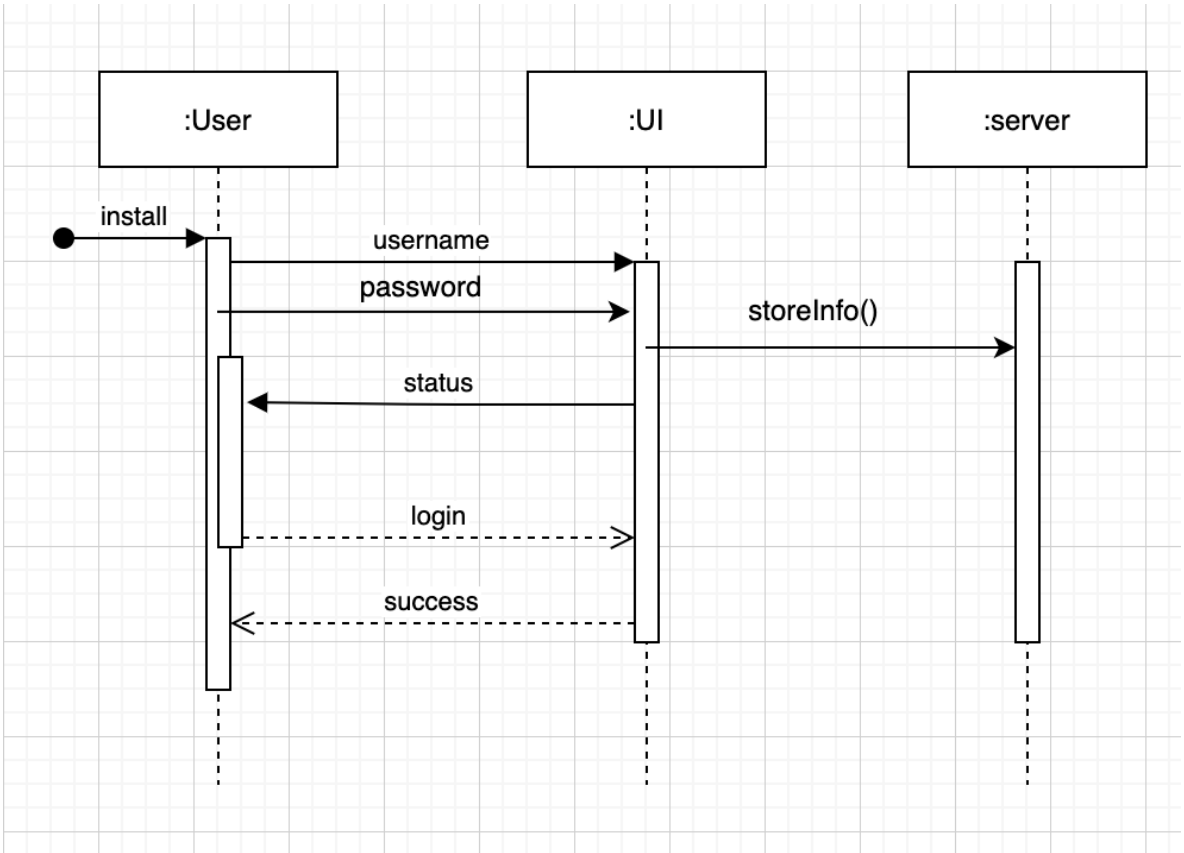


Fig 2.5 Sequence diagram for user login info

3c Proposed System Architecture

Virtual rooms are based on the client server architecture where different users are synchronously connected to a single server and interact with each other via the server. The server will help to establish synchronized data structures which will be shared among the different clients located across different locations.

3d Initial Subsystem Decomposition

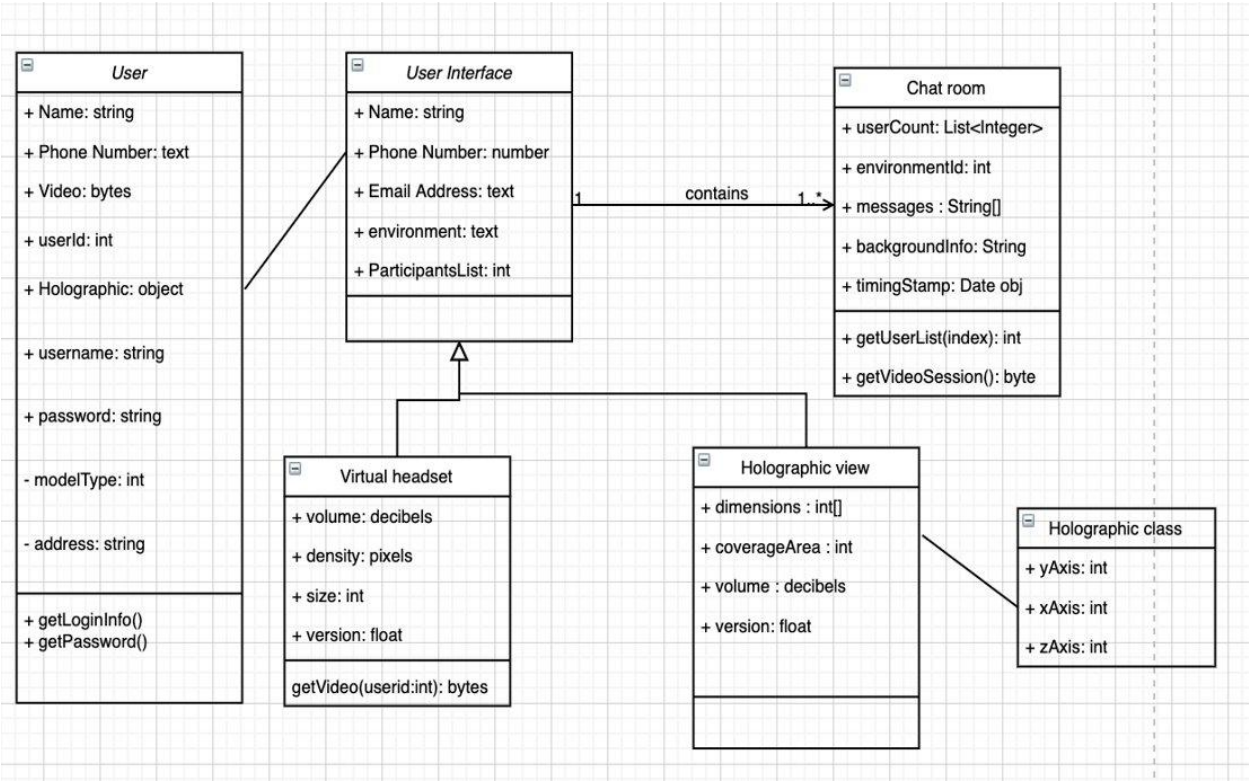


Fig 2.6 Class Diagram 2

1. User subsystem

   The user subsystem consists of the important user credentials that are required for establishing a successful virtual connection among other users. It consists of the users username, password and a video which consist of the 270 degree angle of

the users face This video helps to train the supervised learning module for changing the users virtual face in the virtual environment.

2. User Interface Subsystem

   The user interface subsystem provides an abstract representation of the different environment and modes of communication established in virtual rooms.Two modes which are the Virtual headset view subsystem and the Holographic view subsystem inherit information from this subsystem.

3. Chat room subsystem

   Chat room subsystem provides a basic chat room where the different participants can share different files and documents for the conversations happening inside the virtual environment. The chat will be shared with all the users at the end of the conversation and private conversations can also be conducted between two users during the meetings.

4. Holographic Singleton subsystem

   Holographic subsystem is a singleton class which encompasses the 3-D coordinates of the user and the environment around the user. These coordinates are then mapped into the virtual environment for producing a hologram. It consists of floating point fields such as the x,y and z coordinates.

4 Additional Design Considerations

4a Hardware / Software Mapping

Because Virtual Room requires the use of either the headset or the project hardware in order to connect and interact with the Virtual Room service.

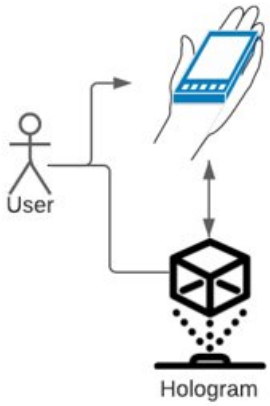


Fig 2.7 Hologram Mapping Figure

Fig 2.8 Headset Mapping Figure

This diagram shows the user as the actor and how the hardware (projector/hologram and the VR headset model) is used as the interface to communicate with the main server and other clients.

4b Persistent Data Management

Since Virtual Room hosts multiple rooms, with many users, the main server that is required to manage communication has to have some way to keep the data persistent. Because memory is extremely expensive and having hundreds of thousands of concurrent users can cause the system to run out of memory, there will have to be a need for data to be persistent in case of an outage, server failure and to ensure the server expenses are kept at a minimal. Due to these constraints, the main server will also have to make sure that the data is also kept under a persistent database. Due to the nature of the service, Virtual Room will be using a relational database as the use of joins and lookups will be very extensive. Additionally, Virtual Room will also need to use a fast search database like Elastic Search, to query full-text results, and this database will need to partially mirror some columns from frequently used tables. Virtual Room has to also ensure that the room data is also stored and is persistent so that users can re-use rooms for future uses. However, the database is not responsible to store any recordings of the sessions.

4c Access Control and Security

To ensure that none of the sessions of the users meeting is getting misused, Virtual Room needs to ensure that all meetings and sessions allow users to download the meeting, but this data is not held within the system. This also gives users a sense of relief as users can rest assured that anything that happens stays hidden. However, with this design we also need a way to report harassment and other ways to report actions.

4d Global Software Control

Virtual Room has the potential to serve hundreds of thousands of concurrent users on a daily basis, and because of this the system needs to scale to this demand. As a result, the system has to be able to scale and if certain parts of the system aren't performing well, creating new subclasses and subsystems should be made easy so that the switch is seamless, without the need for any system downtime. Additionally, packages and software used in the system has to always be up-to-date with the latest and most stable version to make sure that all security vulnerabilities are taken care of and the system cannot be misused. Agile Methodologies allow change in our current system to adapt and to meet demands of our growing consumers.

4e Boundary Conditions

Virtual Room needs to make sure that it prevents users from changing between subclasses without creating the new VirtualRoom object. We will also need to make sure that when the users get disconnected from the system that none of the meeting is held on our system and that all the session data is deleted from our system. Additionally, we need to make sure that when the projector/VR headset is

disconnected Virtual Room is still available for up to 10 minutes for reconnection before removing the user and allowing it to rejoin.

4f User Interface

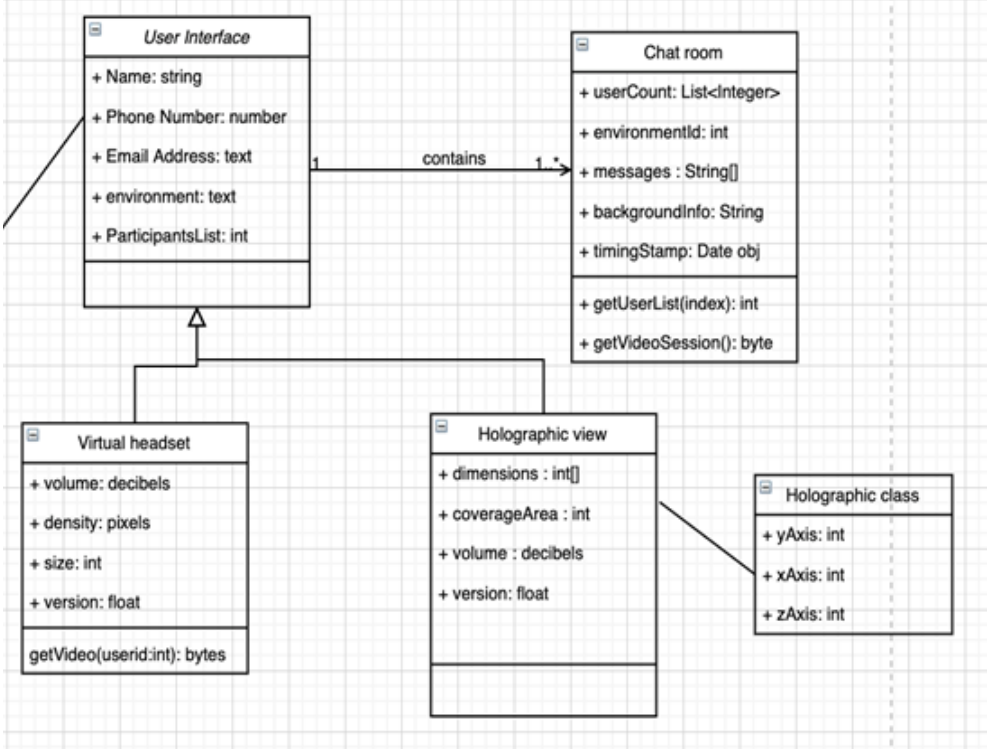


Fig 2.9 Class Diagram 3

4g Application of Design Patterns

Since Virtual Room is a unique product, to ensure that users find the product easy to use, we will make user of user centric design patterns to implement proper UI that are easy to use and employ proper usability features, without sacrificing usability for more advanced users that rely on recall to get their job done faster. Due to the nature of the design pattern, it will be essential of us to test every update of the UI with test users to check how intuitive the design is.

5 Final System Design

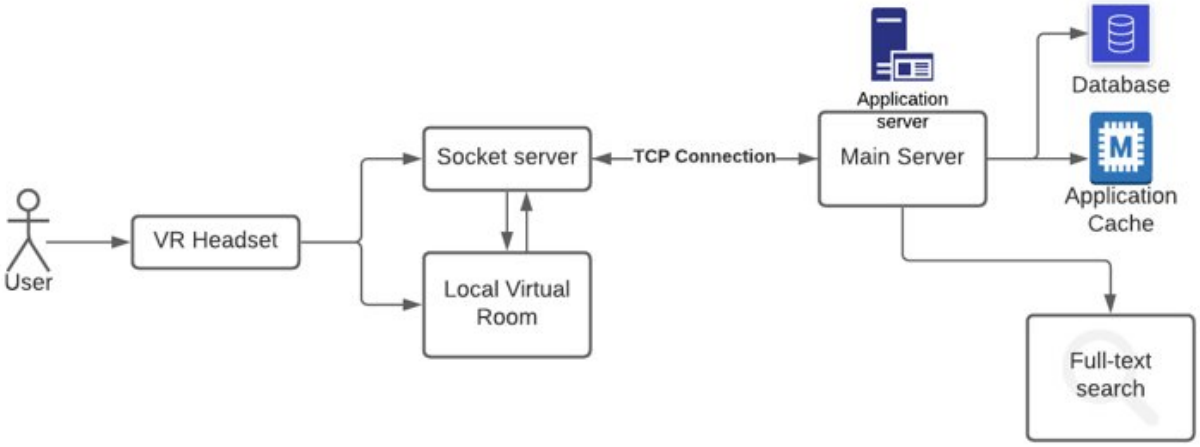


Fig 3.0 System Diagram 1

This diagram shows the system with the actor as the user interacting using the VR headset.

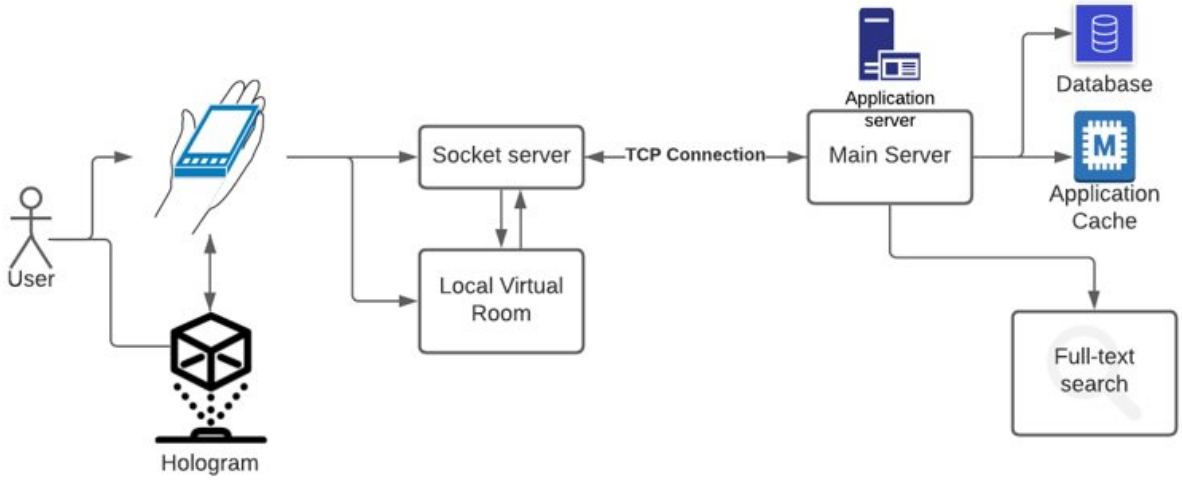


Fig 3.1 System Diagram 2

This diagram shows the system with the actor as the user interacting using a mobile device paired with the hologram/projector.

6 Object Design

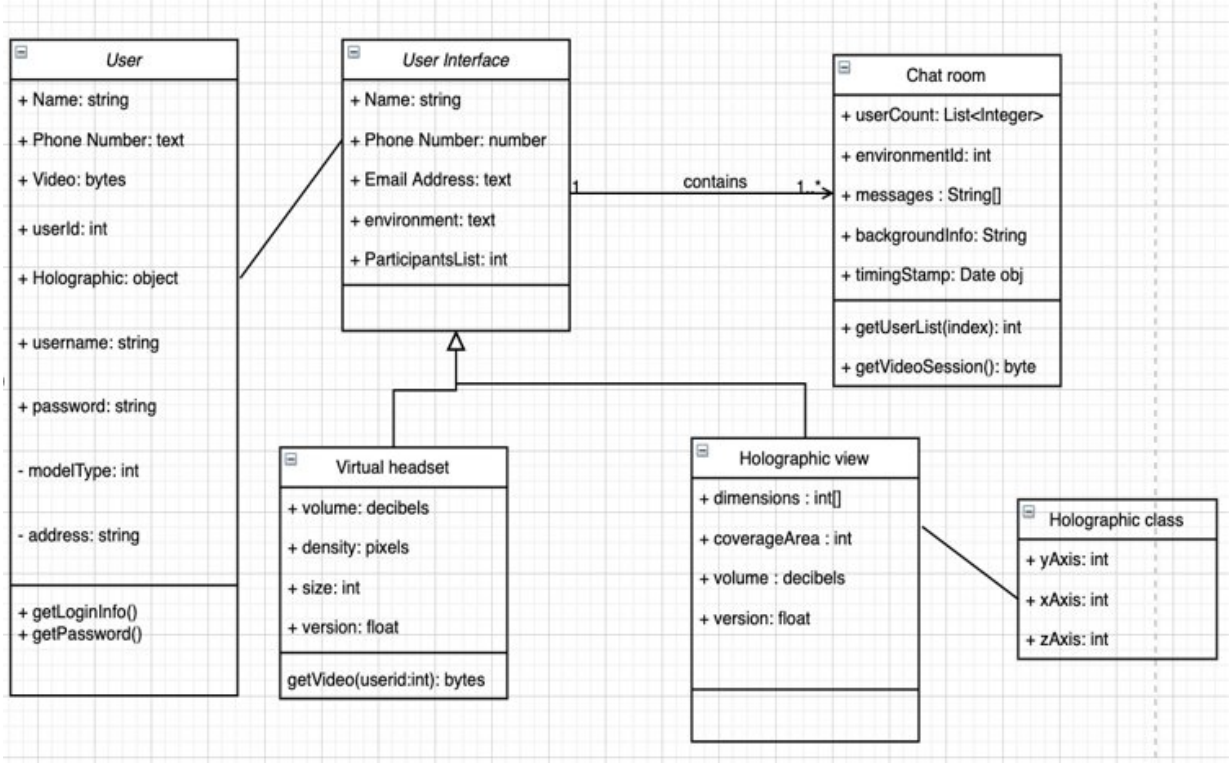


Fig 3.2 Class Diagram 4

6a Packages

- All client side packages that involve the use of the VR headset will be part of the com.virtualroom.vr package
- All client side packages that involve the project/hologram interface will be part of the com.virtualroom.hologram package
- Client socket connection and communication services and classes will be included in the com.virtualroom.clientSocket package.
- Finally the main server (gateway server) will be part of the com.virtualroom.api package

6b Subsystem I

Virtual Headset - Inherits from UI and is a concrete class of implementation

6c Subsystem II

Holographic View - Inherits from UI and is a concrete class of implementation

IV Project Issues

1 Open Issues

Management of the different subclasses of our Virtual Room interface. Each of the subclasses requires a careful implementation of the hardware components available. Some of the issues which need to be addressed

1. Compatibility across platforms: With platform independent applications utilizing different frameworks the programming languages changes which have to be kept in sync with the API provided by the application.
2. User's environment: The external factors play a major role in the performance of the hardware dependent modules and compatibility between components.

2 Off-the-Shelf Solutions

With the increase in the hardware components for the virtual environment, companies have launched platform independent VR headsets which can be connected with different Virtual Rooms and used accordingly. There will be a list of compatible headsets presented at the launch of our product.

2a Ready-Made Products

Many other products can be utilized for the same purpose of the hardware components

Facebook Oculus for the virtual headset can be utilized for entering the virtual environment.

With advancement in the internet of things, tactile sensors can be replaced for the sensor gloves to make the interaction more lively.

2b Reusable Components

The device drivers for many of our headsets can be written with the same libraries that are used for Facebook Oculus so that we create an immersive, real-time experience for the user. Rather than reinventing the wheel, we can take advantage of the improvements set forth by the virtual reality community before us.

2c Products That Can Be Copied

Not Applicable

3 New Problems

3a Effects on the Current Environment

Virtual Room could have a few adverse effects on the level of detail that individuals will provide to their surroundings when using our product. Due to this, the product is recommended to be used in a central location where personal belongings and items are cleared from the vicinity.

3b Effects on the Installed Systems

Through the Projector-Monitored Virtual Room, the new software may cause meeting applications like Zoom and Skype to no longer have relevance in the market. This will cause an advancement for society despite the degradation of those individual companies.

3c Potential User Problems

Users could have a negative response if they have difficulty with using our product. To curtail these issues, we provide several training videos on both the Headset and Projector Monitored Virtual Rooms and also have a help-desk that operates during normal business hours.

3d Limitations in the Anticipated Implementation Environment That May Inhibit the New Product

Physical limitations include loss of internet connectivity, or power. During any case where any of the components come in contact with liquids, there is a high possibility that our product will stop working.

3e Follow-Up Problems

If there is no open area for the Projector-Monitored Virtual Room to project its display, then there will be no guarantee that the user will get an accurate depiction of all the other individuals in the virtual environment. The projector will continue to project its display over the objects in the way.

4 Migration to the New Product

Not Applicable

5 Risks

A huge potential risk that could occur is that we cannot develop software to use the full hardware capabilities of our Projector-Monitored Virtual Room. Another risk is that we cannot develop Machine Learning algorithms to the quality demanded by the consumers. To alleviate these risks, we have to obtain a group of high-performing engineers that have worked on similar projects.

6 Costs

In order to develop this project to the state where it can be available to the public, there will be a substantial amount of resources required. We will require several million dollars in funding to create a prototype of the Projector and Headset-monitored virtual rooms that adequately meets the requirements imposed by our report. It would also take several years to develop a projector that is engineered to adequately capture all aspects of a user's environment. Thus it may be necessary to launch our product with the Headset-Monitored Virtual Room prior to the implementation of our Projector-Monitored Virtual Room.

7 Waiting Room

User-created environments that are depictions of different locations in the world stored by our database systems. Rather than using their current environment, they can use a template generated by our system.

8 Ideas for Solutions

In order to meet the requirements of our project, it is recommended to implement the Virtual Room in C++ using a graphics rendering utility like Unity. We want to have a high quality user-experience where there is minimal lag and frustration. Visual Studio will be an adequate IDE that could handle the different specifications needed.

9 Project Retrospective

Our group worked very well together and learned a lot from our different perspectives. It was crucial that we had a mix of individuals with differing backgrounds because it allowed us to use our strengths to cover each other's deficiencies. To improve it for the future, we could have allocated tasks that we were not familiar with so that it forced us to grow and learn more from each other.

V Glossary

- **Host:** Similar to audience, the term host might also be a little ambiguous, as for certain events the host might also want to be an audience member with special privileges, and in other cases the host might only be able to have an overview of what is going on in the room and is able create games and other events.
- **Libraries:** Defines the code as functionalities which can be included in the applications and softwares.
- **Audience:** This can be a little vague depending on the context. For example, the host can also be an audience member, in family gatherings. But for like a sporting event the host does not have all the functionality that an audience member might have, and might have other administrative features.

- **Room:** A room is simply the place where the specific event takes place in. For example a room could be a courtroom, or a stadium.
- **Virtual environment:** An artificial environment for users to connect and interact with each other.
- **Activities:** An activity is anything that takes place within the room. For example games that were added to the room would be considered activities.
- **Oculus:** VR headset company created by Facebook, that allows developers to make games and other VR related products.
- **Event organizer:** An event organizer can be the host, admin, or even part of the audience. The main job of the event organizer is to manage all the activities, and the setting of the room. Including inviting the audience members. The event organizer is set by the admin or the host.
- **Admin:** The admin is appointed by the host and is able to oversee all parts of the event and can also be part of the audience. The admin can be the host, event organizer, and even the audience member.
- **Full-text search:** A way to store full-text documents in a way that is easy to search and retrieve.
- **Database:** A way to organize and store persistent data in an organized manner that is easy to manage and retrieve.
- **Data structures:** Similar to a database, but holds small amounts of data that is not persistent.
- **Event organizer:** An event organizer is a term used to describe all parties that helped in organizing the event. An admin, host, event organizer are all considered event organizers.
- **Event:** An event can be used to describe a room, and can be used interchangeably.
- **Sentiment Analyzer:** Tool for producing the sentiment of the user based on the user text input.
- **Legal requirements**: list of conditions needed to fulfill to legally deploy a product.
- **Acceptance test:** the testing conditions that are required to ensure the requirements fit the criterion.
- **Sensors**: hardware used to capture certain parameters from the environment as input for the product.
- **GPU**: Graphical processing unit used in Virtual headset devices.

.

VI References / Bibliography

[1] Robertson and Robertson, Mastering the Requirements Process.

[2] A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts, Ninth ed., Wiley, 2013.

[3] J. Bell, "Underwater Archaeological Survey Report Template: A Sample Document for Generating Consistent Professional Reports," Underwater Archaeological Society of Chicago, Chicago, 2012.

[4] M. Fowler, UML Distilled, Third Edition, Boston: Pearson Education, 2004.

VII Index