School Council Election & Voting using Metaverse

Software Requirement Specification

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Introduction to Software Engineering 41

TEAM 4

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1. Introduction

1.1. Purpose

1.1.1 Purpose of Documents

This documentation contains the requirements and specifications on developing the "School Council Election & Voting using Metaverse" project. This document is written and targeted towards Team 4, who will be designing and implementing this project. In addition, it will be used as a reference guide between operations for users who use applications designed based on this document in the future. In short, the purpose of this document is to provide specifications of framework that can be referenced by developers working on the project and subsequent application users by clearly presenting the requirements of the specific field required for project progress to be mentioned below.

1.1.2 Purpose of Systems

The purpose of this document is to specify the requirements for a metaverse project that will be used to streamline the election and voting process for Sungkyunkwan University. The metaverse project will contain all the necessary spaces, functions, and tools to hold an online election from registration, campaign, and voting. In this project, the functions to be provided to users are largely classified into four categories: Visual content Exhibition, Vote & Survey, Debating, Board, with VRChat program to specify related attributes.

In other words, the purpose of presenting projects with these four system functions is to alleviate the problem of lack of real-time communication, reduce the high cost considered during the voting process, and relieve the burden of face-to-face elections and voting that are reluctant in the COVID-19 Pandemic situation.

1.2. Scope

The "School Council Election & Voting using Metaverse" project is geared towards the current state of contactless, online oriented world as many students are staying far from campus due to COVID-19. The system is based on VRChat that will be used to create the metaverse. This metaverse will contain all the necessary tools that previous in-person school council elections have provided and more.

1.3. Definitions, Acronyms, and Abbreviation

The following table contains the acronyms and abbreviations used in this requirements specification document.

[Table 1] Table of acronyms and abbreviations

Acronyms& Abbreviations	**Explanation**
RQ	Requirement
VR	Virtual Reality
ISO	International Organization for Standardization
IEEE	Institute of Electrical and Electronics Engineers

The following table defines certain technical terms used in this document.

[Table 2] Table of terms and definitions

Terms	**Definitions**
Metaverse	A virtual-reality space in which users can interact with a computer-generated environment and other users.
Voter	a person who votes or who has a legal right to vote, especially in an election
Board	Shows the current discussion stage, the agenda, and the remaining time. The remaining theme is reflected in real time.
Chairperson	Chairperson will be responsible for facilitating and moderating the discussion and manipulating the timer. The moderator is given several buttons to operate the stop watch to organize the discussion time
Press Seats	In this position, representatives of each school’s media will be occupied, and they will ask the candidates sharp questions and write the school articles based on them
Student Seat	Students who are interested in the student council election will be seated in this seat, and they will hold a question-and-answer session

Terms	Definitions
	with the student council candidates as student representatives. Students can show their intention to ask a question to the chairperson through the toggle button next to the seat.
Voting Process	Words that encompass the process of voting or questioning using the platform.
VPMS	Voting Process Management System, system for managing all voting processes.
Candidate	Candidate is a person who actually makes a presentation with his or her own opinion in elections or discussions. At the end of the process procedure, a vote is held for the relevant candidates.

1.4. References

- IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications, In IEEEXplore Digital Library http://ieeexplore.ieee.org/Xplore/guesthome.jsp
- VRChat website, https://help.vrchat.com/hc/en-us

1.5. Overview

It is true that the smooth election & voting process is not easy due to the adverse effects of COVID-19 in the process of elections and voting within universities, including Article 4 of the SKKU Student Council Election Rule. Therefore, the overall goal of the project is to increase accessibility and convenience of the election and voting process by implementing a world based on the VRChat platform in the Metaverse world. Based on this, we will classify the core functions in four aspects and specifically mention the interface, requirements, and connections necessary for each function to actually be implemented.

To summarize regarding the overall sequence architecture of this documentation, the composition of this document is as follows. Overall Description, Chapter 2, provides a general overview of the School Council Election & Voting using Metaverse application. This includes descriptions of interfaces, memory constraints, operations, user characteristics, assumptions, and more. Also, the necessary elements for the overall core functions are described. Specific requirement, Chapter 3, contains detailed information on the specification. External interface requirements and performance requirements, design constraints, software system characteristics, and other requirements are discussed in this section. The overall system structure can be formed through specific pictures, tables, and descriptions of each element.

2. Overall Description

2.1. Product Perspective

This product is present to provide flexibility in voting and election processes to non-face-to-face society caused by COVID-19 by implementing four core functions using the VRChat program. Therefore, the characteristics of the product, such as defining the interfaces required to implement core functions and specifying constraints, user characteristics and more are described in detail below.

2.1.1. System Interfaces

The Udon Node Graph is the default interface for creation of Udon programs. The Flow of Udon Node Graph defines which nodes will run, and the order in which they'll do it. It is designed to be secure, performant, and easy to use via the VRChat Udon Node Graph, a built-in visual programming interface that uses nodes and writes to connect flow, inputs, and outputs. It consists of a graph creating step, a graph compiling step, and a graph running step.

2.1.2. User Interfaces

With VRChat, Users access the world based on chatroom and avatar and encounter free 3D social apps. It supports buttons, toggles and sliders, sliders can be 1, 2 and 3 dimensional, a basic keyboard and all receiver elements can use Animation states when activating. Users use Unity Events and or SendMessage methods to invoke scripts when buttons have been pressed. In addition, users play various roles within the world, which can be divided into chairperson, voter, and candidate. Definitions of each role are explained in Section [1.3].

2.1.3. Hardware Interfaces

Intel® i5-4590 / AMD FX 8350 or higher CPU and 4 GB or higher RAM, NVIDIA GeForce® GTX 970 / AMDRadeon™ R9 290 or higher, DirectX version 11 or higher support, storage 1GB or more, and Internet-enabled environment are required. Users can play using a VR headset or keyboard, mouse, or monitor.

2.1.4. Software Interfaces

In this project VRChat programs should be used as a basis. The operating system of Windows 8.1 and Windows 10 and the latest version of the VRChat program must be installed to use the VRChat program.

2.1.5. Communications Interfaces

Both users and service providers need VRChat accounts and avatars used by VRChat to use the service. The service is provided worldwide within VRChat.

2.1.6. Memory Constraints

In the case of RAM, at least 4 GB of RAM is required to run VRChat on a PC. In the case of Disk space, at least 1GB of disk space is required to install VRChat on PC.

2.1.7. Operations

2.1.7.1. Operations of System Manager

Service founders can create new instances in the VRChat world to provide services. When creating a new instance, Users can adjust the invitation authority to set permissions such as whether anyone can enter or only the invited person can enter.

2.1.7.2. Operations of User

Users can access the VRChat program with their VRChat account and access the world instance opened by the service founder to receive services. In this process, the user must set up the 3D avatar they will use in advance. In moving and communicating, users can freely move around the world using the 3D avatar they set within the world instance and communicate with other users using a microphone. Users can play content created through clicks.

2.2. Product Functions

2.2.1. Visual Content Exhibition Module

Visual content exhibition is one of the essential parts of our school council election and voting using metaverse. The goal is to introduce who the candidates are and what their election promises to voters. There are numerous ways to introduce their promises. Thus, we can divide it into three parts. Video content, 2D object and 3D object.

First is the video content. Videos are a good medium for candidates to convince voters. It can give additional and certain explanations to voters. There will be added videos and live streaming service for voters. Our goal is to get videos from urls such as Youtube. Candidates will upload their videos on Youtube. Then, we will use Udon Video Sync Player and add URLs. It will play continuously. Also, for videos that have been already made before the metaverse opens, we will use prefabs provided by VRChat SDK. It can reduce the burden from VRChat.

Second is the 2D object. 2D objects are low size. It is very familiar to voters. Voters can see candidates' election promises or their history. 2D objects could be images, text, etc. Our goal is to give candidates administrators which can upload their objects right away. Object files could be jpg, png, gif, etc. All the components are supported by Unity Engine.

Third is the 3D object. 3D objects are the strengths for this metaverse system. Users can go inside the VRChat and see their promises three-dimensionally. For instance, if candidates promise to redesign some rooms or spaces, they can give view maps to voters. Voters can directly see the before/after and imagine the real scene. 3D objects can be uploaded by .fbx or .obj files. It can also be edited by using MeshRenderer. All the components can be supported by Unity Engine.

2.2.2. Vote & Survey Module

The Vote & Survey system is the core of our system, School Council Election & Voting. Organizations authorized to create the voting process can conduct elections or surveys through this system. The system includes three processes: registration of voting processes, participation in voting processes, and broadcasting of voting processes. These processes are carried out and managed by one 'Voting Process Management System(VPMS)'.

If an organization authorized to create an election wants to create a voting process, request the VPMS to create a process. The process voting requestors send the request to the VPMS, including process purpose, voting item, process progress time, etc. The VPMS checks whether the organization is authorized, and is there any empty process space at the requested time. If all requirements are satisfied, the system schedules the voting process.

Users(or voters) can also participate in the voting process by requesting the VPMS. If the user selects the process he or she wants to participate in, the VPMS will receive the process id and user id to verify that the user has voting rights. If authorized, move the user to the voting space. VPMS also saves the user's selection later.

Finally, ongoing processes relay the status outside the voting space. Save users' choices and relay the process progress through an external display board. When the voting process is completed, it will be deleted from the relay board and the results can be inquired separately.

2.2.3. Debating Module

Debating is an activity that verifies the qualifications of candidates, the direction of the student council, the reality of the promises, and the adequacy of the promises through an open discussion among the candidates, the school press, and the students. This process can help students decide how to exercise their voting rights, and can also help candidates identify and fill in gaps in their promises.

The main actors participating in the debating include candidates for the president and vice president of the student council representing each election headquarters, current students who want to verify the candidates, the school press, and the chairperson who coordinates the debating. Each actor will have a constructive discussion for the right student council culture according to the direction of the chairperson.

Debate basically consists of a keynote presentation, press Q&A , student Q&A , and debate between candidates. However, there are cases where there is only one registered candidate. In the case of a single candidate, the debating process between the candidate teams is deleted, but the question time with the audience is increased.

To make the debating fair and smooth, there is a time limit for speaking at each stage, which is controlled using a timer object. This timer can only be operated by the chairperson and the timer is displayed on the board behind the chairperson so that all actors participating in the debating can see the remaining speaking time.

2.2.4. Board Module

Board Module provides text-based communication within the VRChat world. The manager can write the contents of the entire event as a notice, and candidates and general users can communicate with each other through question and answer. Operations such as writing posts, checking the list of written articles, and reading written articles are implemented to operate similar to actual Internet bulletin boards. In the board module, it can be classified into three main functions.

Notice: The Chief Executive Officer may write a notice about elections and voting.

Q&A: The general user can create a query. The elector or manager may answer each question.

Free bulletin board: Ordinary users can freely post articles. Other users can leave emotional expressions such as 'Like' in the article.

2.3. User Characteristics

The service founder is a person who has knowledge of the world and can smoothly proceed and supervise all contents. Create a new instance in the VRChat world to provide services. Not only knowledge within the world but also overall knowledge of VRChat programs is needed to facilitate the progress of each content. Service users need basic knowledge of VRChat and the services they provide. In the case of knowledge about VRChat, Users must have an account, set up a 3D avatar, move around the world with other users, and use the content provided. Only students enrolled in Sungkyunkwan University who have the right to vote can use the content.

2.4. Constraints

The system will be designed and implemented based on the contents mentioned in this document. Other details are designed and implemented by selecting the direction preferred by the developer, but the following items are observed.

- Use the technology that has already been widely proven.
- Avoid using technology or software that requires a separate license or pays for royalty. (Exclude this provision if this is the only technology or software that the system must require.)
- Decide in the direction of seeking improvement of overall system performance.
- Decide in a more user-friendly and convenient direction.
- Organize the world with high versatility in preparation for future changes in VRChat.
- All services are provided through the VRChat program.
- Use a general-purpose open source as much as possible, and if necessary, use external files (3D models, images, videos, etc.) in compliance with copyright. Consider the

system cost and maintenance cost

- Consider future scalability and availability of the system
- Optimize the source code to prevent waste of system resources
- Consider future maintenance and add sufficient comments when writing the source code
- Use Unity Engine 2019.4.30f1 version and use the latest VRChat SDK. Icons, pictures, photos, and fonts should be purchased and used in a way that does not violate copyright, or those that are commercially available.
- Regarding how to cope with changes and reflections in additional requirements, Improve the product by conducting feedback with actual Sungkyunkwan University students.

2.5. Assumptions and Dependencies

This document was created assuming the latest version of VRChat. If the VRChat developer deletes or changes the functionality of VRChat, there is a possibility that the service will not be provided smoothly.

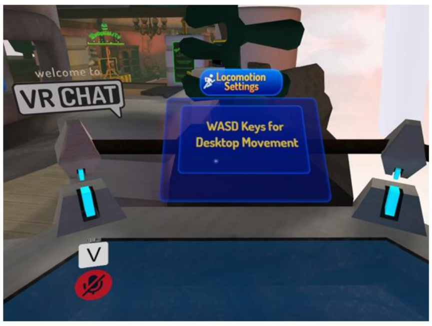
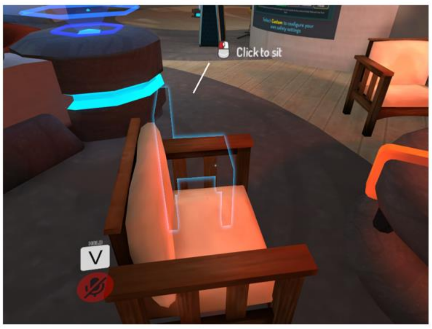
3. Specific Requirements

3.1. External Interface Requirements

3.1.1. User Interfaces

[Table 3] User Interface for manipulating input

Name	Basic User Interaction
Purpose/Description	The user can move the avatar through the input device.
Input source / Output	Keyboard, mouse, or VR headset device.
Destination	N/A
Range / Accuracy / Margin of error	Management in VRChat program
Unit	Clicking or Typing Button & Key

Name	Basic User Interaction
Time / Velocity	Asynchronous input / Immediate execution
Relationship with other input/outputs	After the data input by the user is transmitted to the VRChat server, the server issues a command to the corresponding avatar to proceed with the action the user wants.
Format and configuration of screen	• With the 'WASD' keyboard key, the user can move users' avatar in the desired direction. The user can turn their(avatars') eyes by moving the mouse. • It is possible to reproduce a predetermined action only for interactive objects in the world instance through a mouse click.  welcome to VR CHAT Locomotion Settings WASD Keys for Desktop Movement V <월드 내 표시 화면>  <이동과 클릭을 통한 인터랙티브>
Format and configuration of window	N/A
Data type	Provide by VRChat
Instruction type	Provide by VRChat
Exit message	N/A

[Table 4] User Interface for Video Content

Name	Video Content
Purpose/Description	Every user can access videos that candidates or hosts provided.

Name	Video Content
	They can communicate with each other in live.
Input source/ Output destination	URL / Users, Videos / Users
Range/ Accuracy/ Margin of error	Depends on the internet speed or URL's server, VRChat server speed.
Unit	Screen in metaverse
Time/ Velocity	After users click which videos will be shown / Server speed, URL download speed
Relationship with other input/outputs	Inputs of what the users click the button affects what videos will be returned.
Format and configuration	1. Buttons are shown to users. Users should choose one of them. 2. By which button users choose, videos will be shown. If the videos should come up with a URL, it will take time to download it. If the videos are in the VRChat server, then it will show up right away. 3. Users can change video time or speed, sound etc.
Data type	Udon of button code, Video
Instruction type	Provide by VRChat
Exit message	"Do you want to leave?", "Yes or No"

[Table 5] User Interface for 2D Content

Name	2D object content
Purpose/Description	Every user can see images or other objects that candidates or host provided. Candidates can upload their objects by themselves.
Input source/ Output destination	Images / Users, Text / Users, Animated objects / Users

Name	2D object content
Range/ Accuracy/ Margin of error	Depends on the VRChat Engine.
Unit	Screen or bullet board in metaverse
Time/ Velocity	As soon as users enter the metaverse / Server speed
Relationship with other input/outputs	N/A
Format and configuration	1. As soon as users enter the metaverse, objects such as candidates' election promises or their history are shown. 2. Candidates can upload their objects on their own or give it to the host.
Data type	Images, Text, Animated GIFs
Instruction type	Provide by VRChat
Exit message	N/A

[Table 6] User Interface for 3D Content

Name	3D object content
Purpose/Description	Every user can see spaces or other objects that candidates or hosts provided. Candidates can upload and edit their objects by themselves.
Input source/ Output destination	Spaces / Users, 3D files / Users
Range/ Accuracy/ Margin of error	Depends on the Unity Engine.
Unit	Spaces in VRChat
Time/ Velocity	As soon as users enter the exhibition space / Server speed

Name	3D object content
Relationship with other input/outputs	Users' movement to the exhibition space is an input and shows spaces or objects as an output.
Format and configuration	1. Users enter the metaverse and move to exhibition spaces. 2. Exhibition spaces will change to what the users want to see depending on candidates' promises. 3. Candidates can modify spaces by themselves or give designs to the host.
Data type	.fbx, .obj, .mesh etc
Instruction type	Provide by VRChat
Exit message	"Do you want to leave" "Yes or No"

3.1.2. Hardware Interfaces

[Table 7] Hardware interface of applicable device for the system

Name	Applicable device for the system
Purpose/Description	It requires minimum specifications or higher PCs and high-speed networks required to access VRChat, and VR headsets or input/output devices (keyboards, mice, speakers, etc.) are required to use services provided in the world.

3.1.3. Software Interfaces

[Table 6] Software interfaces of VRChat SDK

Name	VRChat SDK3 v2021.3.4
Purpose/Description	Development a 3D world where user can interact using 3D avatars in the VRChat server
Input source/ Output destination	Host server/ User, User/User, User/Host server
Unit	VRChat World
Time/ Velocity	instant reaction
Relationship with other input/outputs	Host create a world instance in the VRChat server and the user join the world instance
Format and configuration of screen	N/A
Format and configuration of window	N/A
Data type	VRChat World
Instruction type	N/A
Exit message	N/A
Name	VRChat SDK3 v2021.3.4

3.1.4. Communication Interfaces

[Table 9] Communication interface of client and host

Name	Client and Host in VRChat
Purpose/Description	Each client requests the connection to the host, requesting entrance to the host's world instance.
Input source/ Output destination	Host server/ User, User/User, User/Host server
Unit	packet

Name	Client and Host in VRChat
Time/ Velocity	At least 100Mbps
Relationship with other input/outputs	Related to all inputs/outputs from the World instance in VRChat server
Format and configuration of screen	N/A
Format and configuration of window	N/A
Data type	Full Duplex
Instruction type	Requesting Packets
Exit message	N/A
Name	Client and Host in VRChat

3.2. Functional Requirements

3.2.1. Use Case Example

[Table 10] Entering the World

Use case name	Description
Actor	Users who are subscribed to VRChat
Description	The user may access the world instance providing the corresponding service within the VRChat program and use the content.
Normal course	1. If a user log-in to the VRChat program normally, they can find the corresponding instance by touching the world button. 2. If a user touches the GO button on the instance display UI, they will download the world. 3. When the world download ends, the user can use their avatar within the world through the access button.

Precondition	The user must be accessing the VRChat program and the service provider must open a world instance in advance.
Post Condition	If the connection is completed, the user who has accessed the designated location must be located.
Assumptions	N/A

[Table 11] Movement and Communication through the World

Use case name	Description
Actor	The user who accessed the world instance.
Description	Users can freely move within the world, communicate with other users, and use content within the world.
Normal course	1. Users who access the instance have their 3D avatar located at the designated location. 2. Users can move the world freely using a keyboard or VR headset. 3. Feel free to communicate with other users through voice chat through microphones, speakers, or headsets. 4. In the case of interactive content, the user may receive desired content through a click within the range.
Precondition	Shall operate normally and the system is an instance of the World owner must be present in order is necessary to ensure smooth operation.
Post Condition	Click the desired content shall be operated correctly.
Assumptions	Users must use the content they want.

[Table 12] Creating Voting Process

Use case name	Description
Actor	The user or chairperson who wants to host the voting.
Description	If they want to proceed with the voting process using the platform, create the process by entering the type of organization you want to hold, candidates, purpose of the voting process, target voters, and voting items. In order to reduce the load on the server, it limits the number of processes that can be opened at a time, and induces you to select a different time if full.
Normal course	1. Enter the ID of the organization represented (representative) by the user and check whether it is authenticated through the DB. 2. Only when confirmed, details of the voting process are entered. 3. Ensure that the number of allowed processes remains in the input process validity period, otherwise select a different period. 4. Finally, after checking the input information with the user, the reservation is completed.
Precondition	The number of allowed processes must remain in the validity period of the received process.
Post Condition	Information on the voting process should be stored in the database.
Assumptions	Authentication status for each organization is checked through id, and the voting process can be created only for certified organizations.

[Table 13] User authentication and selection of the voting process

Use case name	Description
Actor	System administrator, users related voting process.
Description	Since there may be multiple open processes in a period, users should be able to choose the vote they want. If users want to vote, only designated voters should be allowed to vote. In addition, since there may be cases where account information has not been updated, it once again goes through the process of checking

	whether it is a user with voting rights by entering the school number.
Normal course	1. It shows the ongoing voting process. Brief information on the process, such as target participants and voting periods of each process, can be checked. 2. Select the voting process that the user wants to participate in. 3. Check the user's right to vote by checking the user's school number and DB information. 4. If you are identified as a user with voting rights, move the user to a voting space where you can participate in the voting process.
Precondition	The voting process and school number to participate in should be clearly identified.
Post Condition	If they have the right to vote, they must move to the voting space where they can participate in the selected voting process.
Assumptions	If users do not have the right to vote, it is decided to send a notification that they do not have

[Table 14] User voting and Counting voting status

Use case name	Description
Actor	Voter, Chairperson related to specific Voting process
Description	In order to reduce the systematic load, users vote in one space, but cannot confirm the choice of another. In the case of the election process, the election rate is disclosed at regular intervals. Users and a chairperson can visually check the process process.
Normal course	1. The user submits a response to the questions required by the participating process. 2. When all questions are answered, they are sent out of the voting space with a notification that the participation is completed. 3. In the case of the election process, the percentage of votes updated on the electronic display outside the voting space is aggregated and shown at regular intervals.

Precondition	In order to prevent the campaign in the space, communication such as conversation and chatting between users is controlled.
Post Condition	When the user completes the process, a notification should be sent that the voting is complete. In the case of the election process, the vote rate must be sent by message.
Assumptions	It is assumed that responses to each question of those participating in the vote are received normally.

[Table 15] Completion of Voting Process

Use case name	Description
Actor	Voter, Chairperson related to specific Voting process
Description	When the voting process is completed, the results of the voting process are delivered to the host. The results will be announced to the Voter later depending on whether or not the vote is disclosed.
Normal course	1. After completing the process, the results of the voting process are sended to the host. 2. The results will be announced to the Voter later depending on whether or not the vote is disclosed.
Precondition	Excluding the tally of voters who did not participate in the vote before the process was completed.
Post Condition	Sending notifications between results transmissions and executing statistics should be carried out normally.
Assumptions	It is not considered errors between result transmission.

[Table 16] Multiple Candidates Debate

Use case name	Description
Actor	Chairperson, Candidates, School press, Student audience

Description	Two or more candidates will have time to discuss various topics, followed by a Q&A session with the audience. The speaking time of each candidate should not exceed the given time, and a timer is used by the chairperson to regulate this speaking time.
Normal course	1. Keynote presentation (3 minutes): Each candidate presents a blueprint for the activities of the Student Council. 2. Debate between Candidates (60 minutes): Student council representatives discuss various topics. 3. Break time (10 minutes): As each takes a break, the candidates rearrange their speeches, and the audience prepares questions. 4. Student Q&A (30 minutes): Audience students and candidates will have a Q&A session at the site. The chairperson randomly selects a questioner from among the students who want to ask a question. 5. Press Q&A (90 minutes): The university press and candidates will have a Q&A session at the site. The content discussed during this time may be published in the university newspaper. 6. Etc. (-): If additional questions or presentations are required, they are conducted at this stage.
Precondition	Ensure that only verified audiences and candidates are present at the site.
Post Condition	Students who did not attend the public hearing should also be able to see the issues addressed in the public hearing.
Assumptions	Audiences and candidates must follow the direction of the chairperson for the debating to proceed.

[Table 17] Single Candidate Debate

Use case name	Description
Actor	Chairperson, Candidate, School press, Student audience
Description	The required process is similar to that for multiple candidates. But the

	discussion stage between candidates has been eliminated because it is a single candidate. Instead, keynote speeches on various topics and Q&A time with the audience have been increased.
Normal course	1. Topic #1 (45 minutes) 1. Keynote presentation (3 minutes): Each candidate presents a blueprint for the activities of the Student Council. 2. Student Q&A (10 minutes): Audience Students and candidates will have a Q&A session at the site. The chairperson randomly selects a questioner from among the students who want to ask a question. 3. Press Q&A (32 minutes): The university press and candidates will have a Q&A session at the site. The content discussed during this time may be published in the university newspaper. 2. Topic #2 (45 minutes) 1. Keynote presentation (3 minutes) 2. Student Q&A (10 minutes) 3. Press Q&A (32 minutes) 3. Break time (10 minutes) 4. Topic #3 (45 minutes) 1. Keynote presentation (3 minutes) 2. Student Q&A (10 minutes) 3. Press Q&A (32 minutes) 5. Topic #4 (45 minutes) 1. Keynote presentation (3 minutes) 2. Student Q&A (10 minutes) 3. Press Q&A (32 minutes)
Precondition	Ensure that only verified audiences and candidate are present at the site.
Post Condition	Students who did not attend the public hearing should also be able to see the issues addressed in the public hearing.
Assumptions	Audiences and candidate must follow the direction of the chairperson

	for the debating to proceed.

[Table 18] Write a Notice on The Notice Board

Use case name	Description
Actor	Chairperson
Description	Chairperson can write a notice on the board. Notices may contain any information related to voting or elections. Submitted notices are freely viewable by all.
Normal course	1. Chairperson can create a notice post with the title and content. 2. Chairperson submits the post when the writing is completed. 3. Registered posts are synced to everyone.
Precondition	It must be verified that the writer's identity is a chairperson.
Post Condition	Posts created should be synced to everyone. There is a limit on the length of the title and content of the post.
Assumptions	There are no errors in the process of writing the text.

[Table 19] Write a Question on The Q&A Board

Use case name	Description
Actor	Voter
Description	Voters can write questions to the Q&A board. Questions may contain any information related to voting or elections. Submitted questions are freely viewable by all.
Normal course	1. Voters can create a question post with the title and content. 2. Voters submit the post when the writing is completed. 3. Registered posts are synced to everyone.
Precondition	N/A
Post Condition	Posts created should be synced to everyone. There is a limit on the

	length of the title and content of the post.
Assumptions	There are no errors in the process of writing the text.

[Table 20] Write a Answer on The Q&A Board

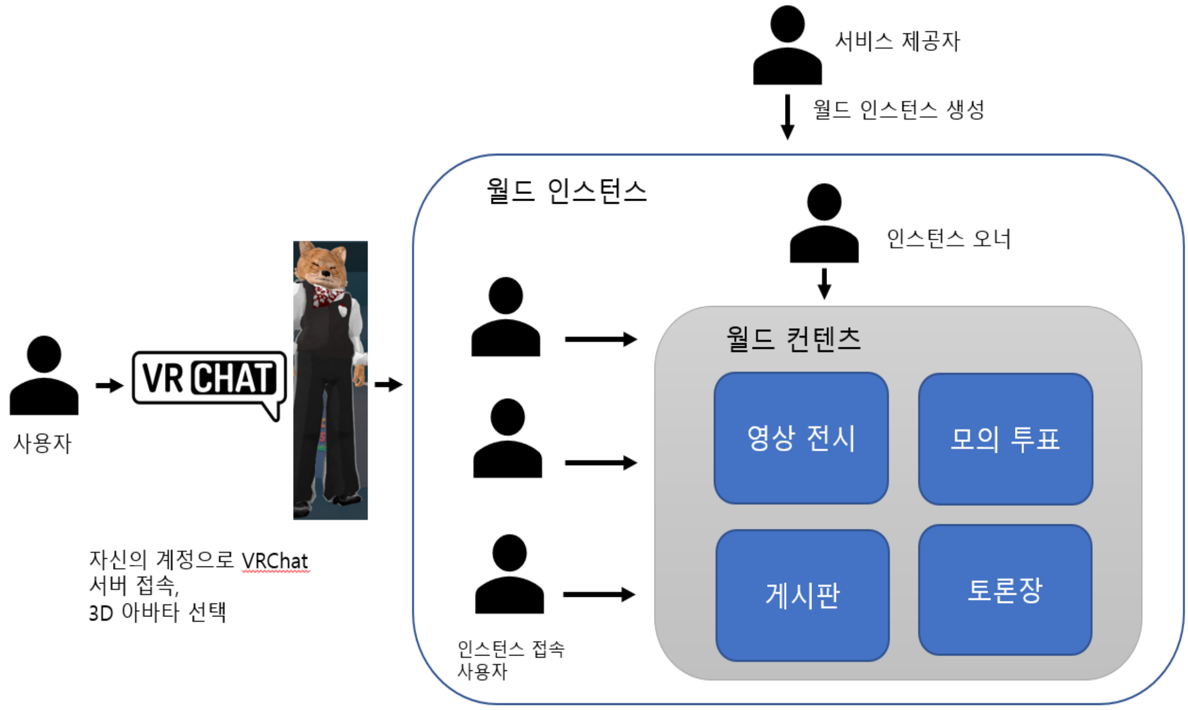
Use case name	Description
Actor	Chairperson, Candidate
Description	Candidates can view the questions written on the Q&A board and write the corresponding answers. Submitted answers are freely viewable by all.
Normal course	1. Candidates check the questions written on the Q&A board. 2. Candidates fill out the answers to the questions and submit them. 3. Registered posts are synced to everyone.
Precondition	It must be verified that the writer's identity is a chairperson or a candidate.
Post Condition	Posts created should be synced to everyone. There is a limit on the length of the title and content of the post.
Assumptions	There are no errors in the process of writing the text.

[Table 21] Write a Free Post on the Free Board

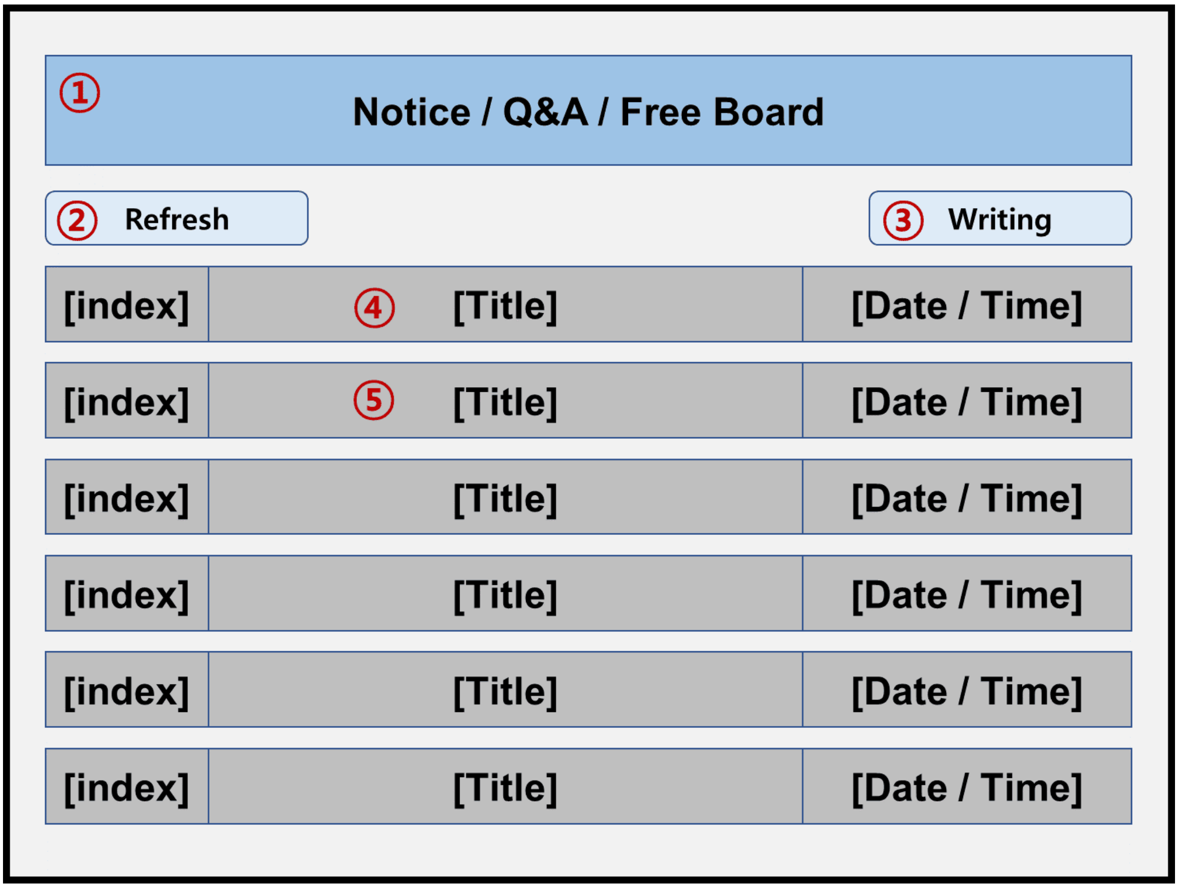
Use case name	Description
Actor	Chairperson, Candidate, Voter
Description	Anyone can write questions to the free board. Submitted posts are freely viewable by all.
Normal course	1. Anyone can create a notice post with the title and content. 2. Anyone submits the post when the writing is completed. 3. Registered posts are synced to everyone.
Precondition	N/A

Post Condition	Posts created should be synced to everyone. There is a limit on the length of the title and content of the post.
Assumptions	There are no errors in the process of writing the text.

3.2.2 Use Case Diagram



[Figure 1] Diagram about creating world instance and user’s accessing



[index]	[Title]	[Date / Time]
[index]	[Title]	[Date / Time]
[index]	[Title]	[Date / Time]
[index]	[Title]	[Date / Time]
[index]	[Title]	[Date / Time]
[index]	[Title]	[Date / Time]

[Figure 2] Post list in Board Module

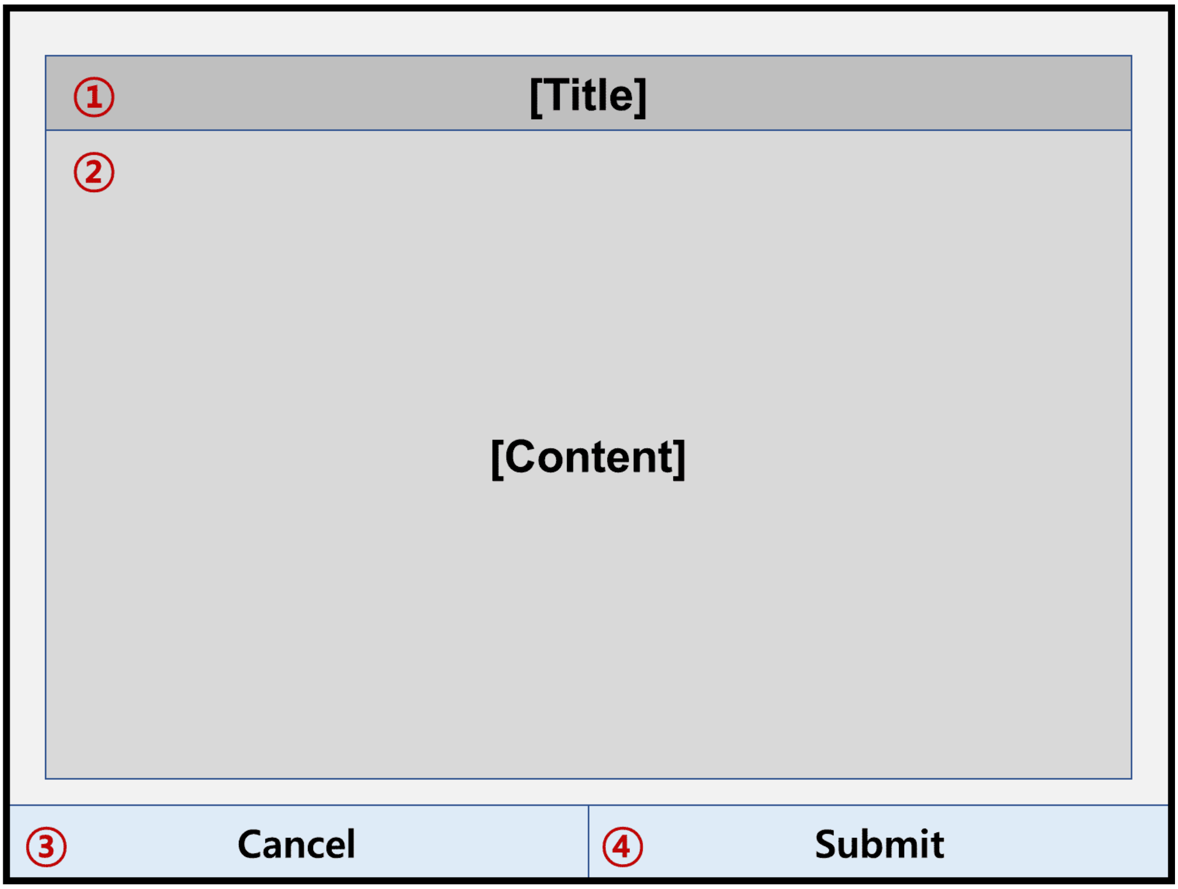
1. List of recently created posts, index, title, and creation time of each post.

2. When clicking the refresh button in the post list, check the newly created post and update the post list.

3. When the user clicks the post creation button, go to the post creation screen.

4. Record and indicate the index of the created post, the created time user ID, etc.

5. When clicking on the post list, go to the content screen of the post.



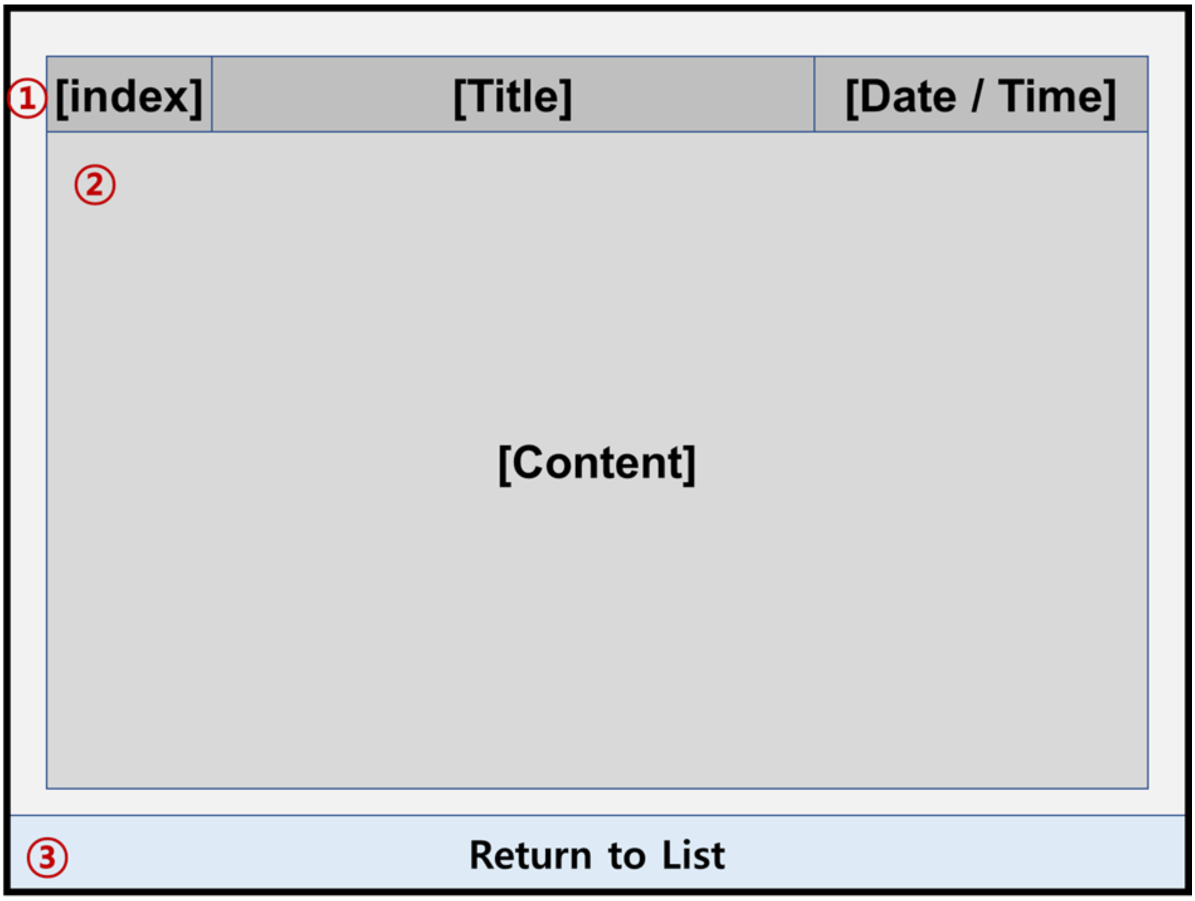
[Figure 3] Writing Post Menu in Board Module

1. (within a specific length) Post can be titled.

2. Users can designate the body of the post (within a certain length).

3. Cancel writing, delete the entire content while writing, and move to the post list screen.

4. Submit writing, save what they wrote as an instance in the world, and synchronize with others.

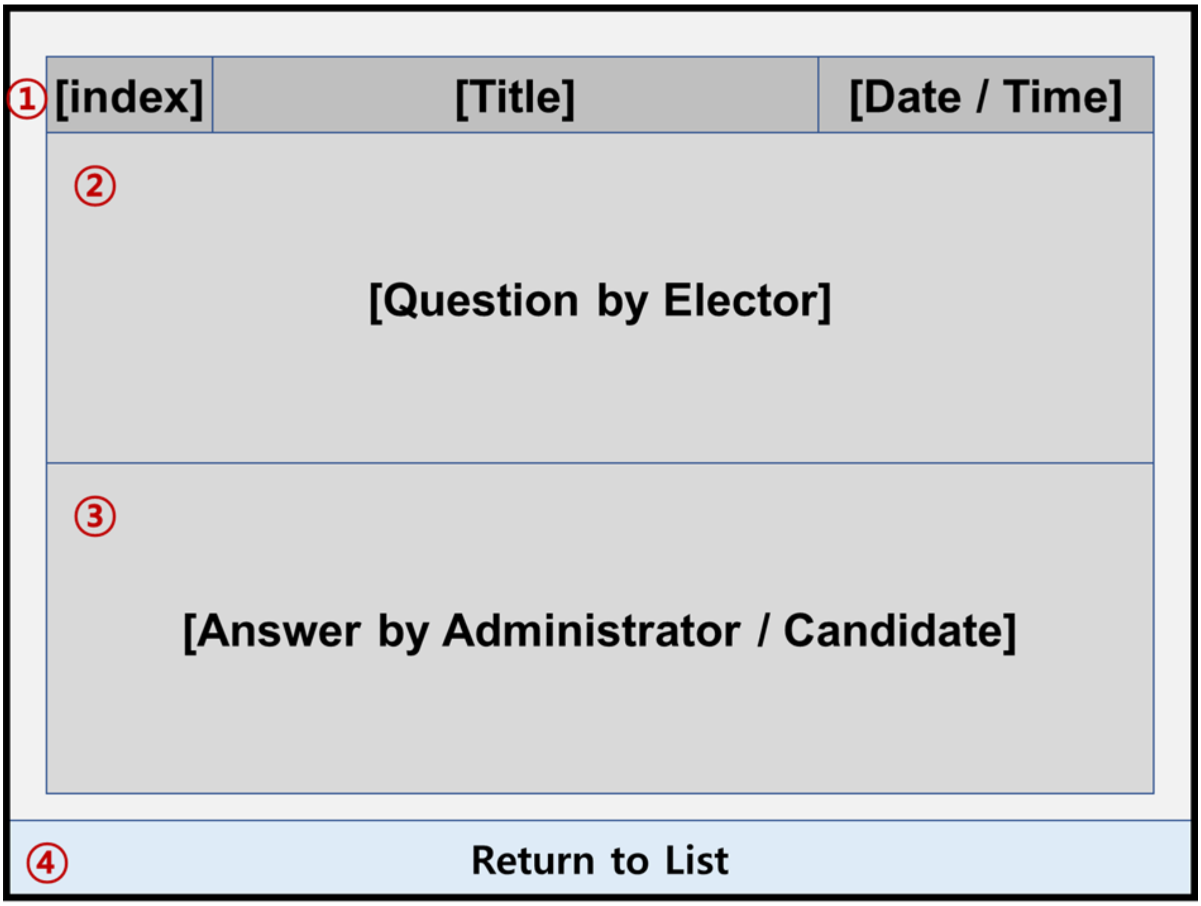


[Figure 4] Viewing Post Menu in Notice Board Module

1. The index, title, writing time, and content of the created post are displayed.

2. Users can view the body of the post.

3. Return to the post list screen.



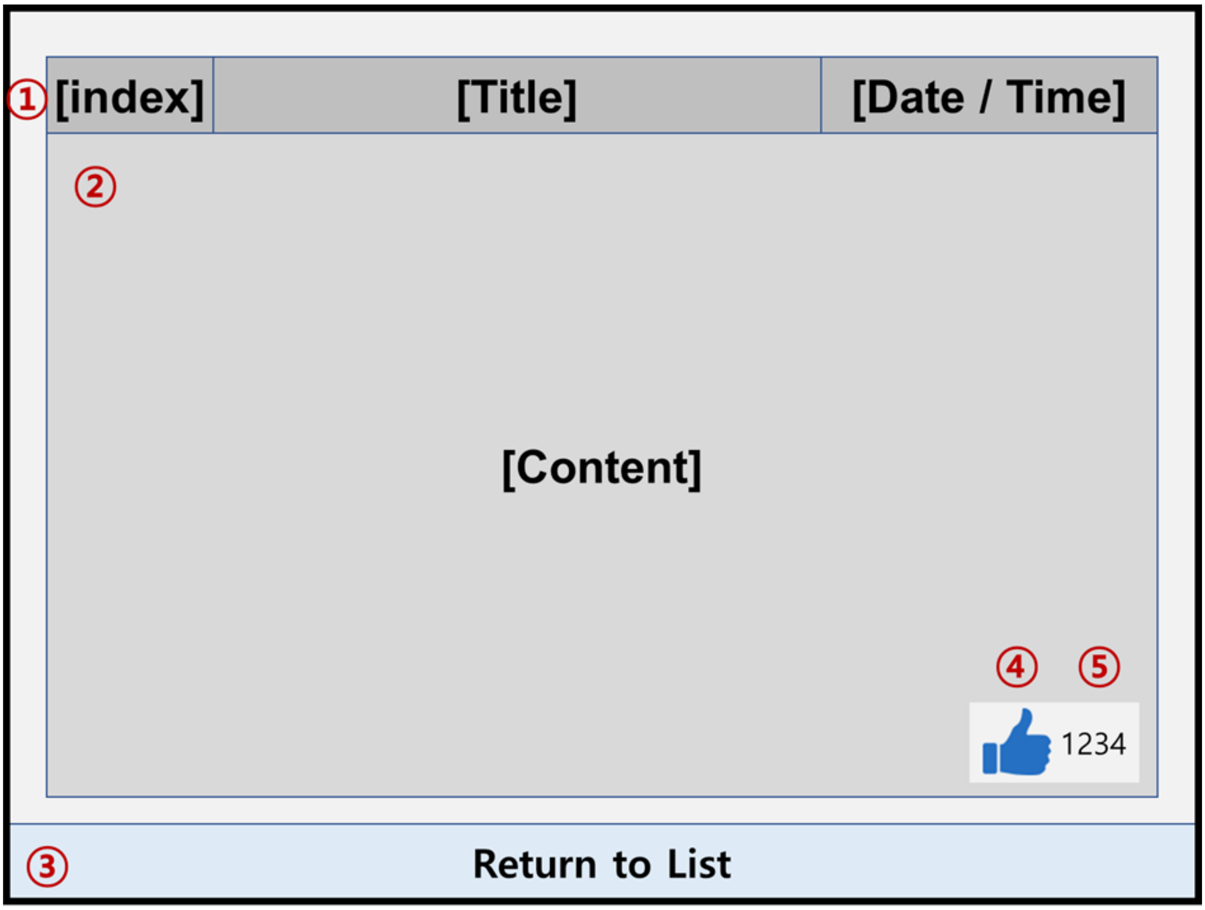
[Figure 5] Viewing Post Menu in Q&A Board Module

1. The index, title, writing time, and content of the created post are displayed.

2. Users can view the body of the question.

3. Users can view the body of the answer.

4. Return to the post list screen.



[Figure 6] Viewing Post Menu in Free Board Module

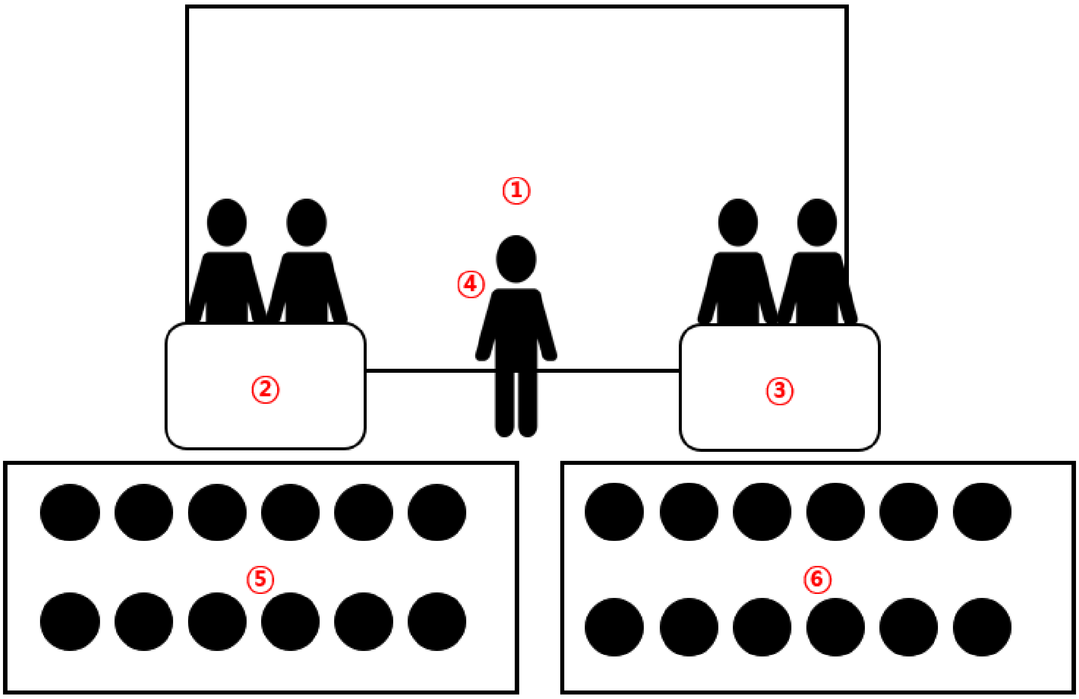
1. The index, title, writing time, and content of the created post are displayed.

2. Users can view the body of the post.

3. Return to the post list screen.

4. Users can click the like button on the post.

5. Displays the number of likes given to the post.



[Figure 7] Debating Overview Diagram

1. Board: Shows the current discussion stage, the agenda, and the remaining time. The remaining time is reflected in real time.

2. This is the candidate's desk, where candidate No. 1 will be seated.

3. This is the desk for selection, and candidate 2 will be seated in this seat. If there is a single candidate, this desk will be vacated.

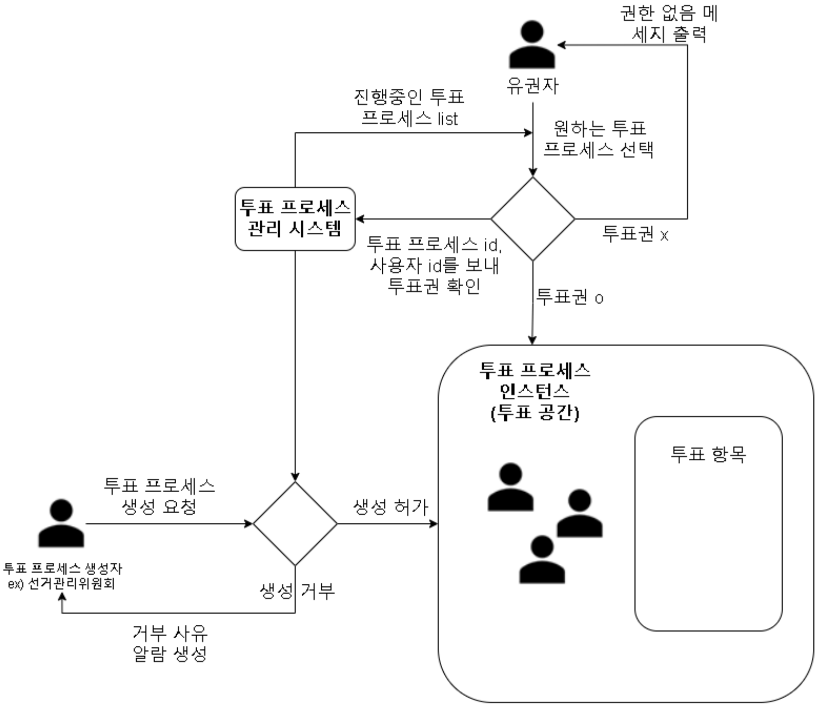
4. Chairperson: He or she will be responsible for facilitating and moderating the discussion and manipulating the timer. The moderator is given several buttons to operate the stop watch to organize the discussion time.

5. Press seats: In this position, representatives of each school's media will be occupied, and they will ask the candidates sharp questions and write the school articles based on them..

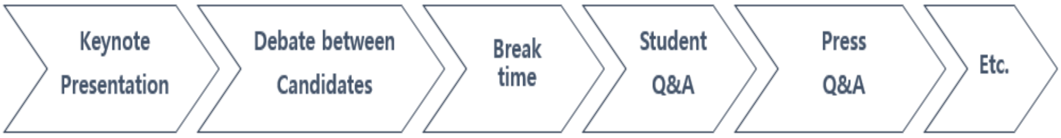
6. Student seat: Students who are interested in the student council election will be seated in this seat, and they will hold a question-and-answer session with the student council candidates as

student representatives. Students can show their intention to ask a question to the chairperson through the toggle button next to the seat.

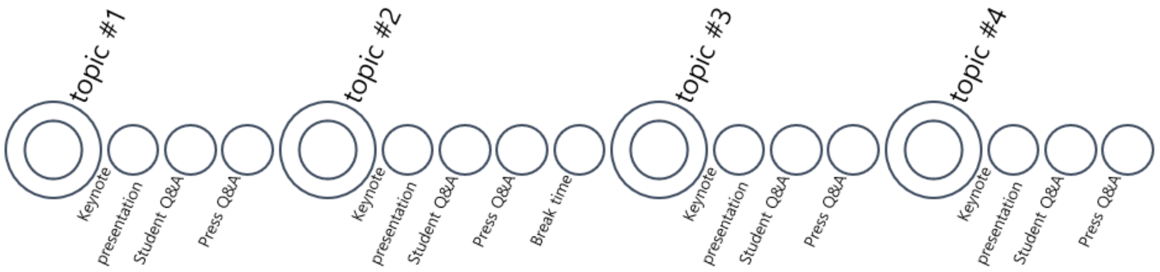
3.2.3 Data Flow Diagram



[Figure 8] Diagram of overall Vote & Survey process



[Figure 9] Diagram of Debating Flowchart in case of multiple candidates



[Figure 10] Debating Flowchart in case of single candidate

3.3 Nonfunctional Requirements

3.3.1 Product Requirements

This section covers the product requirements that are used to specify and constrain the behavior during execution of the software system. The requirements are as follows.

3.3.1.1. Usability Requirements

The purpose of this system is to replace the existing school council election voting process so that more people can participate even with the current state of COVID-19. The target demographic is all SKKU students that can participate in the voting and school council process. As such the system has to be easy to use without prior technological knowledge. Thus, the user interface should be intuitive to use for any university student.

Also, user input error due to lack of clarity or confusion should be avoided especially since one of the functions on offer includes the voting process.

In short, the user experience has to be intuitive and easy to use for any university student.

3.3.1.2. Dependability Requirements

The dependability of the system is vital, especially for the voting process. Redundant systems and active backup needs to be in place so that the votes can still be accounted for during or after a system failure.

3.3.1.3. Security Requirements

The system should provide through authentication and records to prevent election frauds such as voter impersonation and voting multiple times. The system also has to keep minimal amounts of personal information, especially the ones that can link a user to their votes. Secret ballot is one of the fundamental keystones of modern day voting and as such must be maintained. No user including the administrator should have any information linking voters and the ballet they have casted while maintaining voting functionality. To achieve this the system should only check if the voter has voted or not and the actual vote should be counted anonymously.

3.3.2 Organizational Requirements

Organizational requirements are a consequence of organizational policies and procedures based on specific users' organizational context. In other words, the organizational requirement considered from the developer's point of view in this project is free. The context of being free here means that it will never be considered implementations that may be a problem other than implementation to carry out the purpose of the project.

3.3.2.1. Environmental Requirements

The system's interface should use VRchat to create the metaverse. Authentication should use the SKKU's login system and student id. If there are information changes in SKKU, it has to be reflected in this project to update.

3.3.2.2. Development Requirements

Each student logs in to the metaverse using their SKKU credentials. The system provides information and services related to the election process with an easy to understand interface. Each room should be loaded within 10 seconds.

3.3.3 External Requirements

This section covers the requirements that come from external factors from the system and development.

3.3.3.1. Regulatory Requirements

The system has to abide by the student council election rules of SKKU. It also has to maintain the secret voting system in a metaverse environment. In addition, rules and provisions on elections and voting observed by SKKU should not be violated and should be reflected correctly.

3.3.3.2. Ethical Requirements

No user, including the system administrator should be able to view the voting process or possess information that can link individuals with their casted votes.

3.4 Performance Requirement

Multiplayer experiences are the heart of VRChat, so creating a world that reacts to players and synchronizes the data between them is key.

Variable sync is limited to roughly 200 bytes per serialization. A single synced string can have roughly 126 characters. It is also considered that users can send out about 11kb per second.

First of all, it is necessary for the user to have the minimum hardware interface mentioned in section 2.1.3. After that, it does not deviate from the framework of performance provided by VRChat in implementing the School Council Selection & Voting World. (It is sufficient)

3.5 Design Constraints

Services in the World Instance are available to all students. This system is available in the latest version of VRChat. The administrator can create a world instance within the VRChat server and adjust each content with the owner's authority.

3.6 Standards Compliance

The world that will provide the system is produced by Unity Engine, and the services that will be provided to users in the world are produced through Udon, which is officially supported by VRChat. When creating a service, it is produced only for the functions specified within Udon. Other matters follow the ISO and IEEE standard proposals.

3.7 System Evolution

In this section, we describe the fundamental assumptions on which the system is based, and any anticipated changes due to hardware evolution, changing user needs, and so on. This section is useful for system designers as it may help them avoid design decisions that would constrain likely future changes to the system.

3.7.1 Limitation and Assumption

- About movement and communication through the world, Users must use the content they want.
- About creating voting process, authentication status for each organization is checked through id, and the voting process can be created only for certified organizations.
- About user authentication and selection of the voting process, if users do not have the right to vote, it is decided to send a notification that they do not have.
- About user voting and counting voting status, it is assumed that responses to each question of those participating in the vote are received normally.
- About completion of voting process, it is not considered errors between result transmission.
- About multiple candidates debate, audiences and candidates must follow the direction of the chairperson for the debating to proceed.
- About single candidate debate, audiences and candidate must follow the direction of the chairperson for the debating to proceed.
- About writing a notice on the notice board, there are no errors in the process of writing the text.
- About writing a question on the Q&A board, there are no errors in the process of writing the text.
- About writing an answer on the Q&A board, there are no errors in the process of writing the text.
- About writing a free post on the free board, there are no errors in the process of writing the text.

3.7.2 Evolutions of Hardware and Change of User Requirements

As for hardware's evolution, the current project is based on the VRChat platform, so it is necessary to keep up with their latest policies. For changes in user requirement, continuous software updates are needed by accepting feedback from users and reporting inconveniences.

The improvement of the user interface is also changed based on the user's changed requirements.

4. Supporting Information

4.1. Software Requirement Specification

This software requirements specification was written in accordance with the IEEE Recommendation (IEEE Recommended Practice for Software Requirements Specifications, IEEE-Std-830).

4.2. Document History

[Table 22] Document History

Writer	Description
Gwanjong Park	✓ Dividing roles and duties ✓ Drafting a document form and collecting documents written by members. ✓ Modifying and supplementing the overall contents of the document except for product functions & functional requirements. ✓ Meeting document format and writing a table of contents.
Seungji Lee	✓ Drafting Section 1 and 3.3
Daeun Lim	✓ Product Functions, Fuctional Requirements related with ‘Debating Module’
Soyoung Park	✓ Product Functions, Fuctional Requirements related with ‘Vote & Survey Module’
Hojin Jeon	✓ Product Functions, Fuctional Requirements related with ‘Visual Content Exhibition Module’
Jiho Jang	✓ Product Functions, Fuctional Requirements related with ‘Board Module’
Jungin Lee	✓ Product Functions, Fuctional Requirements related with ‘VRChat’ ✓ Backend constraints & requirements