

UNICORN

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A. Requirements Engineering

A1. Introduction

UNICORN is an educational auxiliary software provided by a third-party platform. Because of COVID-19, the demand for distance education has surged, and the deficiencies in existing education software have affected the efficiency and effectiveness of education. The purpose of this software is to increase attentiveness of students during online classes by increasing the interactivity of online classes and to provide a platform with smoother teaching/learning experience. So that teachers and students will have better user experiences when conducting distance education.

UNICORN provides functions as follows:

- **Text Channels:** Text channels allow users to send and receive messages with or without embedded multimedia. Users are allowed to create more text channels based on needs, and there are options for controlling whether a specific group of users is able to send or even view messages in the channel.
- **Voice Channels:** Voice channels act as a group chat room with screen sharing options available, mainly for use of an online session. Users can minimize the group chat, allowing them to access other channels while in a voice channel. Users can mute/unmute their microphone, and a user with admin rights is able to mute another user in the same voice channel. A user with admin rights is also able to record a voice channel.
- **Quiz system:** Quizzes can be added to online sessions and recording lessons. Users with admin rights can launch quizzes in the middle of a voice channel call or add quizzes in voice channel recordings at specific timestamps. The results will be summarized and analyzed and a report will be delivered to the quiz creator. Alternatively, with some changes in the options, assignment collection can be done through quiz channels.
- **Reward mechanics:** The reward mechanics reflect a user's progress in the form of points. Users are awarded with corresponding points after completing different learning activities, and those who have accumulated enough points can unlock special customizations such as different colored names and medals to be displayed next to names.

Further functions:

- **Voice recognition and output:** Through voice recognition, generate specific language voice and subtitles (support multilingual display), and this function supports both live and recording.
- **Portal and Memo:** Use the right click to open a menu containing portal and memo options. Portal perform a Google search on selected content at any time with you want. Memo provide users with editable memos anytime, anywhere and it will be stored in personal profile.

- **Recording lessons editing:** The recording lessons will be edited into corresponding parts according to the course materials, and users can click any course content to watch the corresponding recording lesson.

Scope

The scope of the design is limited to the design of the end-user platform of UNICORN only.

In the design of this system, it is assumed that all users accounts are already properly registered and are already added into their corresponding classrooms and we only consider the use cases within online education.

Some further assumptions are:

- A reference of reward mechanics will be provided, but the specific reward levels is determined by the rewarders themselves.
- All earned points are only valid during the academic year and will be cleared at the end of each academic year.

A2. Requirement Analysis

The requirements for the UNICORN are split into two sections: functional and nonfunctional. Each group of requirements is identified by a major number, for example, 1. Each individual requirement within a group is given a major and minor number, for example 1.1. Further details of the requirement are given by numbers after the corresponding number of the requirement, for example 1.1.1 provides further details for 1.1, 1.1.1.1 provides further details for 1.1.1.

-Functional Requirements

1. General

- 1.1 The system must provide support for the English, Chinese, Spanish, French, Portuguese, German, Italian language.
- 1.2 There has to be a “Teacher” account type for the classroom creator, and a “student” account type for all other members. The “Teacher” account type should provide admin rights to the user that owns it.
- 1.3 Program should allow users to create multiple classrooms.
- 1.4 Program should allow classroom admins to create multiple channels of different types.

- 1.5 Program should allow users to switch between different classrooms and channels by clicking their icons in a list.
- 1.6 The users' names, account types, the record memos and all items that come from the reward mechanism, should be displayed in the user profile by clicking the user accounts' usernames.

2. Text channels

- 2.1 A text channel should allow users to send messages in text.
- 2.2 A text channel should allow users to embed multimedia.
- 2.3 Messages should be displayed chronologically, together with sent time and author.
- 2.4 The program should notify users if there are unread messages in the text channel.
- 2.5 If a user accesses a text channel with unread message, the channel should scroll to the first unread message, otherwise, the channel should scroll to the latest message.
- 2.6 Programs should allow users with admin rights to modify different account types' access levels to different text channels.
- 2.7 There has to be auto-generated text log channels for voice channel recordings and attendance.

3. Voice channels

- 3.1 A voice channel should allow users to broadcast sound from device or/and device sound input to all other users in the channel.
- 3.2 A voice channel should allow users to mute/unmute, unless restricted by administrators.
- 3.3 A voice channel should allow users to listen to all other unmuted users in the voice channel at the same time.
- 3.4 A voice channel should also allow screen sharing from one or multiple users at the same time.
- 3.5 Users should be able to access other types of channels while in a voice channel.
- 3.6 Users with admin rights should be able to record a screen sharing session in a voice channel.
- 3.7 Users should be able to access the voice channel recordings though a text channel afterwards.
- 3.8 The program should allow users with admin rights to integrate one or more quizzes in different timestamps of a recording.
- 3.9 Users with admin rights should be able to start a live quiz while in a voice channel.

4. Quiz System

- 4.1 The system should allow teacher user accounts to construct quizzes and fill in model answers of the quizzes, and quizzes should appear in the form of channels.
- 4.2 A quiz should allow options listed as below:
 - 4.2.1 Whether the quiz is formative or summative.
 - 4.2.2 Whether the quiz is submitted through answering multiple choice questions or a file upload.
 - 4.2.3 Whether the quiz awards fast completion.
 - 4.2.4 The duration of the quiz.
 - 4.2.5 Whether the quiz is integrated into a recording.
 - 4.2.5.1 If the quiz is integrated into a recording, the system should ask for the timestamp in the recording and disable options for 4.2.6 and 4.2.7.
 - 4.2.6 The starting date and time and deadline, with “live quiz” option available.
 - 4.2.6.1 If the user chooses to make the quiz a live quiz, the system should disable options for 4.2.7.
 - 4.2.7 Whether retries are allowed.
- 4.3 Student user accounts should not have access to the contents of the quiz before the start of quiz, and should not have access to answers until the end of quiz.
- 4.4 Student user accounts should have access to the quiz after the start of quiz and should have access to the answers and marks after the quiz.
- 4.5 If the quiz is in the form of multiple-choice questions:
 - 4.5.1 Teachers should be able to receive live-updated quizzes results reports during the quiz.
 - 4.5.2 Teachers should have access to a report covering detailed statistics by student and by question.
- 4.6 If the quiz is submitted in the form of a file upload, the program should allow teachers to input marks and give feedback for each copy received.

5. Reward Mechanics

- 5.1 The system should set the default value of X to 0.
- 5.2 The system should add X point to a student user account, if the student user account signs in within 5 minutes before the start of each online class.
 - 5.2.1 The system should allow teacher user accounts to change the value of X.
- 5.3 The system should add X point to a student user account, if the student user account successfully learns a lesson.
 - 5.3.1 The system should allow teacher user accounts to change the value of X.
- 5.4 The system should allow the changing of student user accounts’ points during online sessions’ quizzes.
 - 5.4.1 The system should add X point to a student user account if it answers the given quiz correctly.
 - 5.4.2 The system should subtract X point for a student user account if it does not

- answer the given quiz twice or more within a limited time during an online session.
- 5.4.3 The system should allow teacher user accounts to change the value of X.
 - 5.5 The system should allow the changing of student user accounts' points during recording lessons' quizzes.
 - 5.5.1 The system should add X point to a student user account if it answers the given quiz correctly.
 - 5.5.2 The system should subtract X point for a student user account if it does not answer the given quiz twice or more within a limited time during an recording lesson.
 - 5.5.3 The system should allow teacher user accounts to change the value of X.
 - 5.6 The system should add corresponding points for a student user account about the formative assignments completed by it after the grades are released within 5 seconds.
 - 5.6.1 The system should allow teacher users to formulate rules for adding points for formative assignments.
 - 5.6.2 The system should add X points for users according to the given rules.
 - 5.6.3 The system should allow teacher user accounts to change the value of X.
 - 5.7 The system should add corresponding points for a student user account about the summative assignments completed by it after the grades are released within 5 seconds.
 - 5.7.1 The system should allow teacher users to formulate rules for adding points for summative assignments.
 - 5.7.2 The system should add X points for users according to the given rules.
 - 5.7.3 The system should allow teacher user accounts to change the value of X.
 - 5.8 Teacher user accounts can provide additional challenge assignments.
 - 5.8.1 The system should add X points to a student user account if it completes additional challenge assignments.
 - 5.8.2 The system should allow teacher user accounts to change the value of X.
 - 5.9 The system should automatically wear a virtual medal for a student user account after reaching the corresponding score within 5 seconds.
 - 5.9.1 The system should automatically wear a silver medal for a student user account after reaching X points.
 - 5.9.2 The system should automatically wear a golden medal for a student user account after reaching X points.
 - 5.9.3 The system should automatically wear a diamond medal for a student user account after reaching X points.
 - 5.9.4 The system should allow teacher user accounts to change the value of X.
 - 5.9.5 Student user accounts can only display the highest-level virtual medals they have received.
 - 5.9.6 Student user accounts can choose whether to hide the virtual medals they have received.

6. Voice recognition and output

- 6.1 The system should perform voice recognition for given voices.
- 6.2 The system should output the content of voice recognition in the form of voice and subtitles.
 - 6.2.1 The system should allow users to choose to output voice only or subtitles only.
 - 6.2.2 The system should allow users to choose whether to output multilingual subtitles.
- 6.3 The system should provide users with multiple selectable output languages.

7. Portal

- 7.1 The system should provide users with a portal function when the user selects some contents.
- 7.2 The system should perform a Google search for the content selected by a user when the user uses the portal function.
- 7.3 The system should provide a separate display window for search results.

8. Memo

- 8.1 The system should provide users with a memo function based on the use of the memo module.
- 8.2 The system should allow users to create multiple independent memos.
- 8.3 The system should provide user accounts with a variety of selectable text colours and symbols for emphasis.
- 8.4 The system should automatically save the content of the memo module being used in the corresponding user account every 5 minutes.
- 8.5 The system should allow user accounts to freely modify the memos.

9. Recording lessons editing system

- 9.1 The system should allow user to merge the recordings with the materials (any type of file).
- 9.2 The system should allow user to export the edited recording into location where user selected.
- 9.3 The system should make the lessons materials into hyperlinks to link the corresponding part of recording lessons when teacher users use this function.

-Non-Functional Requirements

1. Usability

- 1.1 The system shall enable the user to select the language among English, Chinese, Spanish, French, Portuguese, German, Italian language.
- 1.2 The system should provide a simple and intuitive user interface for users to perceive functions immediately.

2. Reliability

- 2.1 The UNICORN shall be available for 99.9% of operating time.
 - 2.1.1 The Unicorn use the server provided by the school, the service will not be interrupted during the normal operation of the school
 - 2.1.2 The Unicorn users can choose to use our server and upload their files to ensure that our services can be used normally under special circumstances
 - 2.1.3 The Unicorn uninterrupted service every time when update
- 2.2 The UNICORN shall be designed to have a servicing interval of at least in 1 months.
 - 2.2.1 The Unicorn check whether it need to be updated every time users open the software
 - 2.2.2 The Unicorn updated content will be pre-loaded in the first two days of the update
 - 2.2.3 The Unicorn security patch update once a month
 - 2.2.4 The Unicorn function update every three months
 - 2.2.4.1 The Unicorn feature updates will be optimized based on existing features
 - 2.2.4.2 The Unicorn feature updates based on user feedback
 - 2.2.5 The Unicorn users can choose to use the available version updated three months ago (Before the last feature update)

3. Efficiency (include Performance and Space)

- 3.1 Performance
 - 3.1.1 The system must respond within a reasonable amount of time to ensure that the customer does not believe the system has crashed.
 - 3.1.2 The system must identify customers' chosen language by voice recognition or alert the user that the language could not be recognized within 10 seconds.
- 3.2 Space
 - 3.2.1 The system must fit within the physical boundaries occupied by the existing terminals.
 - 3.2.2 The system must have sufficient space to be able to support up to a million users.
 - 3.2.3 The system must be able to handle operation requests from multiple users

at the same time.

4. Interoperability

- 4.1 The system must correctly integrate with the ES&P database for user accounts and all shared resources.

5. Support

- 5.1 The system must support the user for all types of learning environments.
- 5.2 The system should provide users with two applications on PC and mobile.
- 5.3 The system should be compatible with most operating systems, such as Windows, MacOS, Linux, Android, IOS etc.
- 5.4 The system should be compatible with most browsers, such as Chrome etc.
- 5.5 The system should not require the user to download an external program.

6. Implementation

- 6.1 The system should be designed in Unified Modelling Language.
- 6.2 The PC application of the system should be written in C++ language.
- 6.3 The mobile application of the system should be written in Java language.

7. Safety

- 7.1 The system must ensure that all user account information and user operations are safe.

8. Privacy

- 8.1 The system must provide a high-level of security at all stages to protect the privacy of all user accounts.
- 8.2 The system must minimize the risk of accidental disclosure of user account information.
- 8.3 The system should allow users to choose whether to share their user information with other users.

9. Standards

- 9.1 Users must comply with the University Code of Practice.

10. Disability assistance

- 10.1 The system must be able to help disabled users.
- 10.2 The system must provide the hearing impaired with auto-captions in multiple languages.
- 10.3 The system must provide auto-captions for auditory disability.

- 1 The use case starts when the teacher user clicks the “create quiz” button on the quiz channel.
- 2 The teacher user chooses either Summative or Formative.
- 3 The teacher user selects submission form of quiz.
 - 3.1 If the teacher user selects “file upload”, the system allows the teacher user to select the options. E.g. size of file, how many files can be uploaded and file form.
- 4 The teacher user inserts the content into the quiz model.
- 5 The teacher user selects whether the quiz awards fast completion.
 - 5.1 If the teacher user selects “fast completion”, the system allows the teacher user to insert score box depending on ranking.
- 6 The teacher selects whether the quiz is “Live quiz” or not.
 - 6.1 If the teacher user selects “Live quiz”, the system automatically whether to retry or not sets to “No”.
 - 6.2 If the teacher user does not select “Live quiz”, the teacher can select whether the quiz can be retried or not and set the duration of the quiz.
- 7 The teacher user clicks the “Complete” button.
- 8 The system shows pop-up window to ask the teacher user whether to end the quiz creation.
 - 8.1 If the user chooses “Yes”, the system automatically saves the quiz and quiz list is updated then return to the quiz channel page.
 - 8.2 If the user chooses “No”, the system returns to the quiz editing.
- 9 The teacher user creates a new voice channel and sets it up as desired.
- 10 The teacher user requests a student user to join voice channel.
- 11 The System automatically checks attendance then save attendance rate on the text channel.
- 12 The teacher user can select the quiz on the list when the teacher user wants while the users attend voice channel.
- 13 The system shows a pop-up window to ask the teacher user whether the user wants to give a quiz or not.
 - 13.1 If the teacher user chooses “yes”, the system automatically stops screen sharing then put the selected quiz on the screen.
 - 13.2 If the user chooses “no”, they system removes pop-up window.
- 14 The student user finishes a quiz then choose to submit the quiz.
- 15 The system shows a pop-up window to confirm the student user’s submission.
 - 15.1 If the student user chooses “Yes”, the system submits the user’s quiz then get the right score depending on the setting.
 - 15.2 If the student user chooses “No”, the system returns to the quiz page.
- 16 When the time limit is over, the student user automatically receives a solution of the quiz.
- 17 The teacher user receives the quiz answers from the student user.
- 18 The teacher continues the voice channel then screen sharing resumes.

Post-conditions

1. The quiz is updated on the quiz section of the personal page of student user.
2. The reward score is updated.
3. The teacher user's personal page is updated with the student users' answer sheets, average score and individual scores.

Scenarios

Scenario 1

Dr Dey plans to start a live lecture and launch a live quiz, he logs in with his teacher account and enters the corresponding classroom, then he chooses "create quiz" in the quiz channel. He chooses "Formative" when the system asks him about the property of this quiz. He then selects multiple choice as the quiz model, and inserts 3 multiple choice questions. He sets the time limit to 3 minutes, makes each question is worth 1 reward point. Dr Dey sets award of quick completion, since this quiz is formative and he wants to encourage all students to actively answer these questions. He sets that the first 10 students who finishes this quiz can get 1 more point. Also, because he wants a live quiz he chooses "Live quiz" option on this page. He then clicks "Complete", and chooses "Yes" when the system asks him to confirm. After that, he creates a new voice channel, invites students to join, and records the attendance rate, then he starts the lecture. After finishes part 1, he selects the quiz he just created from the quiz list and begins the live quiz to check the students' understanding of part 1. One of the students, Harry, finishes the quiz after 2 minutes and chooses "Submit", but when the system asks him to confirm the submission, he chooses "No", then changes the answer of question 2, finally he clicks "Submit" again and chooses "Yes", and he gets the feedback of his mark. The quiz automatically stops after 1 more minute and the system releases the solutions to students. Dr Dey receives the correct rate of this quiz, and then continues the lecture.

Scenario 2

Dr Twin logs in with her teacher account and enters the classroom that she

needs, and she chooses “Create quiz” in the quiz channel. The quiz is set up as a summative quiz by her. She chooses “File upload” and selects a short answer question file to upload, she sets the time limit to 3 minutes, sets this quiz as a live quiz. She sets a high number of reward points, which is 5 points, since this question is summative. Then she does not set the award of fast completion because she wants all students answer questions calmly in a summative quiz. Dr Twin then clicks “Complete”, but she chooses “No” when the system asks her to confirm, and changes the time limit to 5 minutes, then she clicks “Complete” again and chooses “Yes”. She creates a new voice channel, then invites students and mentions that there is a summative live quiz. After students join this channel, she records the attendance rate. When she finishes the first topic, she selects this quiz from the quiz list and starts the quiz. The quiz automatically stops after 5 minutes and the system releases solutions to students. Dr Twin receives the answers from students and she continues the lecture.

Use case: Recording editing

Actors: Student user, Developer

Preconditions

1. The user has an individual account and stay in logged in.
2. The user selected preferred language.
3. The user already has recording of each lecture which he took.

Flow of events

- 1 The use case starts when the user has selected recording in personal page.
- 2 The system lists all the recordings on the page.
- 3 The student user specifies recording editing.
- 4 The student user selects the recording user want to edit.
- 5 The student user sets preferred aspect ratio and content mode.
- 6 The student user splits the recording and removes unnecessary parts.
- 7 The student user customizes the recording with editing tools.
 - 7.1 If the user selects the audio editor, editors allow the user to edit audio recording and record voice himself.
 - 7.2 If the user selects the text editor, editors allow the user to reload his memo, create label, and turn on auto-generated captions.

- 7.3 If the user selects PIP editor, editors allow the user to add image and further videos.
- 8 The student user chooses resolution of recording.
- 9 The student user sets name and choose export location in user's own device.
- 10 The student user sets name and choose export location.
- 11 The student user clicks export.
- 12 The system asks the student user whether to confirm the recording export.
 - 12.1 If the student user chooses "Yes", the system exports the recording.
 - 12.2 If the student user chooses "No", the system returns to the editing state.
- 13 The new recording is saved in a location designed by the user.

Post-conditions

1. The user has received the recording he edited correctly.
2. The system allow user to re-edit the recording that edited by the user previously.

Scenarios

Scenario 1

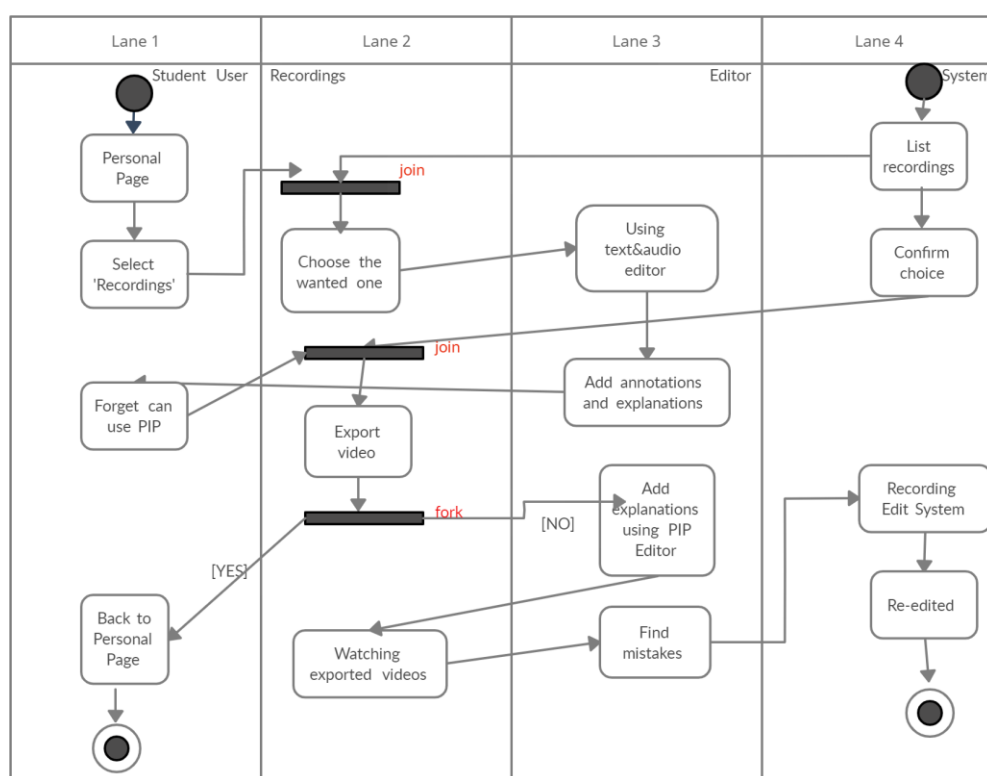
Miss. Anny is a student user of UNICORN. She wants to abstract the important parts from the lecture recording video to help herself reviewing. Anny clicks into 'personal page' and selects 'recording'. The system shows a list of lecture recordings. Anny choose the lecture of this week and starts to edit it. First of all, she sets the preferred aspect ratio and content mode. Anny thinks the introduction part is unnecessary compare with other contents when she is reviewing, so she selects this part and deletes it. After adjusting the video's length, Anny decides to edit audio recording and record her voice explanation during the recording by using audio editor and her voice can be recognized by auto-generator subtitle. She also adds some labels and notes on the video by using text editor, it is more direct to remind Anny those knowledges. She finishes to organize the important parts, then chooses a resolution of recording and a specific location on PC. Anny clicks export, the system asks her confirm this exportation and she selects 'yes', this video is exported as a set name 'reviewing_material7' on her PC.

Scenario 2

Mr. Alan is a student user of UNICORN. He wants to make some recordings easier to understanding for himself. Alan clicks into 'personal page' and selects 'recording'. The system shows a list of lecture recordings. Anny choose the lecture that he feels difficult and starts to edit it. He chooses a suitable aspect ratio and content mode and uses text editor and audio editor to adding annotations and explanations.

When he is ready to click 'export' to export this video, the system asks him to confirm his choice, the Alan realizes he also can use PIP editor to add images and videos in the lecture recording, so he chooses 'No' and the system returns to the editing state. Alan continuous adds graphic explanations in both image and video ways by using PIP editor. After this, Alan confirms his exportation and able to watch this video on his PC. However, when Alan watches this video, he finds out that there are some mistakes of his annotations. He logs into the recording editing system again and there are his edit records. The system allows Alan re-edit the recording that edited by the Alan previously.

B4. Activity Diagram



B5. Class Analysis

-Noun-Verb Analysis

In order to identify our candidate classes, we performed a noun/verb analysis, using the specification outlined by our use-cases and requirements. The following table of nouns were identified as potential classes, and the following table of verbs were suggested as

potential operations

Word/Phrase	Accepted	Reason
User	NO	This is far too general to be a class.
Student	NO	This is far too general to be a class.
Teacher	NO	This is far too general to be a class.
Admin	NO	This is far too general to be a class.
Profile	Profile	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.
Edit Profile	editProfile	This is a particular action of the Profile and hence becomes a method.
View Profile	viewProfile	This is a particular action of the Profile and hence becomes a method.
Language Support	LanguageSupport	This is suitable as a class for all of the support for languages.
Text Channel	TextChannel	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.
Send Message	sendMessage	This is a particular action of the Text Channel and hence becomes a method.
Receive Message	receiveMessage	This is a particular action of the Text Channel and hence becomes a method.
Send Document	sendDocument	This is a particular action of the Text Channel and hence becomes a method.
View Document	viewDocument	This is a particular action of the Text Channel and hence becomes a method.
Voice Channel	VoiceChannel	This is a particular component

		of the system that allows users' account to be accessed and hence should be a class of its own.
Voice Sharing	voiceSharing	This is a particular action of the Voice Channel and hence becomes a method.
Video Sharing	videoSharing	This is a particular action of the Voice Channel and hence becomes a method.
Create Classroom	createClassroom	This is a particular action of the Voice Channel and hence becomes a method.
Join Classroom	joinClassroom	This is a particular action of the Voice Channel and hence becomes a method.
Recording	recording	This is a particular action of the Voice Channel and hence becomes a method.
A user with admin rights	NO	Duplicate
Quiz System	QuizSystem	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.
Create Quiz	createQuiz	This is a particular action of the Quiz System and hence becomes a method.
Launch Quiz	launchQuiz	This is a particular action of the Quiz System and hence becomes a method.
Do Quiz	doQuiz	This is a particular action of the Quiz System and hence becomes a method.
End Quiz	endQuiz	This is a particular action of the Quiz System and hence becomes a method.
Retry Quiz	retryQuiz	This is a particular action of the Quiz System and hence becomes a method.
Generate Result	generateResult	This is a particular action of the Quiz System and hence becomes a method.

Release Answer	releaseAnswer	This is a particular action of the Quiz System and hence becomes a method.
Reward Mechanics	RewardMechanics	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.
Points Statistic	pointsStatistic	This is a particular action of the Reward Mechanics and hence becomes a method.
Change Points	changePoints	This is a particular action of the Reward Mechanics and hence becomes a method.
Launch Present	launchPresent	This is a particular action of the Reward Mechanics and hence becomes a method.
Exchange Present	exchangePresent	This is a particular action of the Reward Mechanics and hence becomes a method.
Name Skin	selectNameSkin	This is a particular action of the Reward Mechanics and hence becomes a method.
Virtual Medal	awardVirtualMedal	This is a particular action of the Reward Mechanics and hence becomes a method.
Voice recognition and output	VoiceRecognitionAnd Output	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.
Voice Recognition	voiceRecognition	This is a particular action of the Voice Recognition And \Output and hence becomes a method.
Output	Output	This is a particular action of the Voice Recognition And Output and hence becomes a method.
Portal	Portal	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.

Auto Search	autoSearch	This is a particular action of the Portal and hence becomes a method.
Memo	Memo	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.
Add Memo	addMemo	This is a particular action of the Memo and hence becomes a method.
Edit Memo	editMemo	This is a particular action of the Memo and hence becomes a method.
AutoSave	autosave	This is a particular action of the Memo and hence becomes a method.
Add Symbols	addSymbols	This is a particular action of the Memo and hence becomes a method.
Change Color	changeColour	This is a particular action of the Memo and hence becomes a method.
Recording lessons editing	RecordingLessonsEditing	This is a particular component of the system that allows users' account to be accessed and hence should be a class of its own.
Edit Recording	editRecording	This is a particular action of the Recording lessons editing and hence becomes a method.
Link Recording	linkRecording	This is a particular action of the Recording lessons editing and hence becomes a method.
Select Language	selectLanguage	This is a particular action of the profile and hence becomes a method.
View Points	viewPoints	This is a particular action of the profile and hence becomes a method.
View Memo	viewMemo	This is a particular action of the profile and hence becomes a method.

Display Virtual Medal	displayVirtualMedal	This is a particular action of the profile and hence becomes a method.
Reply Message	replyMessage	This is a particular action of the text message hence becomes a method.
Apply Language	applyLanguage	This is a particular action of the language support and hence becomes a method.
Use Portal	usePortal	This is a particular action of the text channel hence becomes a method.
Generate Memo	generateMemo	This is a particular action of the text channel hence becomes a method.
View Memo	viewMemo	This is a particular action of the text channel hence becomes a method.
Sign In Class	signInClass	This is a particular action of the voice channel hence becomes a method.
View Current Users	viewCurrentUsers	This is a particular action of the voice channel hence becomes a method.
View Attendance	viewAttendance	This is a particular action of the voice channel hence becomes a method.
Lock Classroom	lockClassroom	This is a particular action of the voice channel hence becomes a method.
Mandatory Stop	mandatoryStop	This is a particular action of the voice channel hence becomes a method.
Break Out Room	breakOutRoom	This is a particular action of the voice channel hence becomes a method.
Extension	Extension	This is a particular action of the quiz system hence becomes a method.
Auto Ending Reminder	autoEndingReminder	This is a particular action of the quiz system hence becomes a method.
Language Transform	languageTransform	This is a particular action of the Voice Recognition And

		Output and hence becomes a method.
Add Links	addLinks	This is a particular action of the Memo and hence becomes a method.

-Responsibility-Driven

Analysis To supplement the noun/verb analysis, we also performed a responsibility-driven analysis to generate CRC (Class, Responsibilities and Collaborations) cards for each candidate class. Responsibilities briefly outline what each candidate class might do, and the collaborators are the classes it will need to interact with in some way.

Profile	
Responsibilities	Collaborators
The responsibilities of this class are to save the user's personal information including name memos, etc.	LanguageSupport RewardMechanics Memo

LanguageSupport	
Responsibilities	Collaborators
The responsibility of this class is to provide users with a variety of optional languages to use the system.	

TextChannel	
Responsibilities	Collaborators
Text channels allow users to send and receive messages with or without embedded multimedia. Users are allowed to create more text channels based on needs, and there are options for controlling whether a specific group of users is able to send or even view messages in the channel.	Portal Memo RecordingLessonsEditing

VoiceChannel	
Responsibilities	Collaborators

Voice channels act as a group chat room with screen sharing options available, mainly for use of an online session. Users can minimize the group chat, allowing them to access other channels while in a voice channel. Users can mute/unmute their microphone, and a user with admin rights is able to mute another user in the same voice channel. A user with admin rights is also able to record a voice channel.	VoiceRecognitionAndOutput Memo RecordingLessonsEditing
---	--

QuizSystem	
Responsibilities	Collaborators
Quizzes can be added to online sessions and recording lessons. Users with admin rights can launch quizzes in the middle of a voice channel call or add quizzes in voice channel recordings at specific timestamps. The results will be summarized and analyzed and a report will be delivered to the quiz creator. Alternatively, with some changes in the options, assignment collection can be done through quiz channels.	Memo

RewardMechanics	
Responsibilities	Collaborators
The reward mechanics reflect a user's progress in the form of points. Users are awarded with corresponding points after completing different learning activities, and those who have accumulated enough points can unlock special customizations such as different colored names and medals to be displayed next to names.	LanguageSupport Quiz

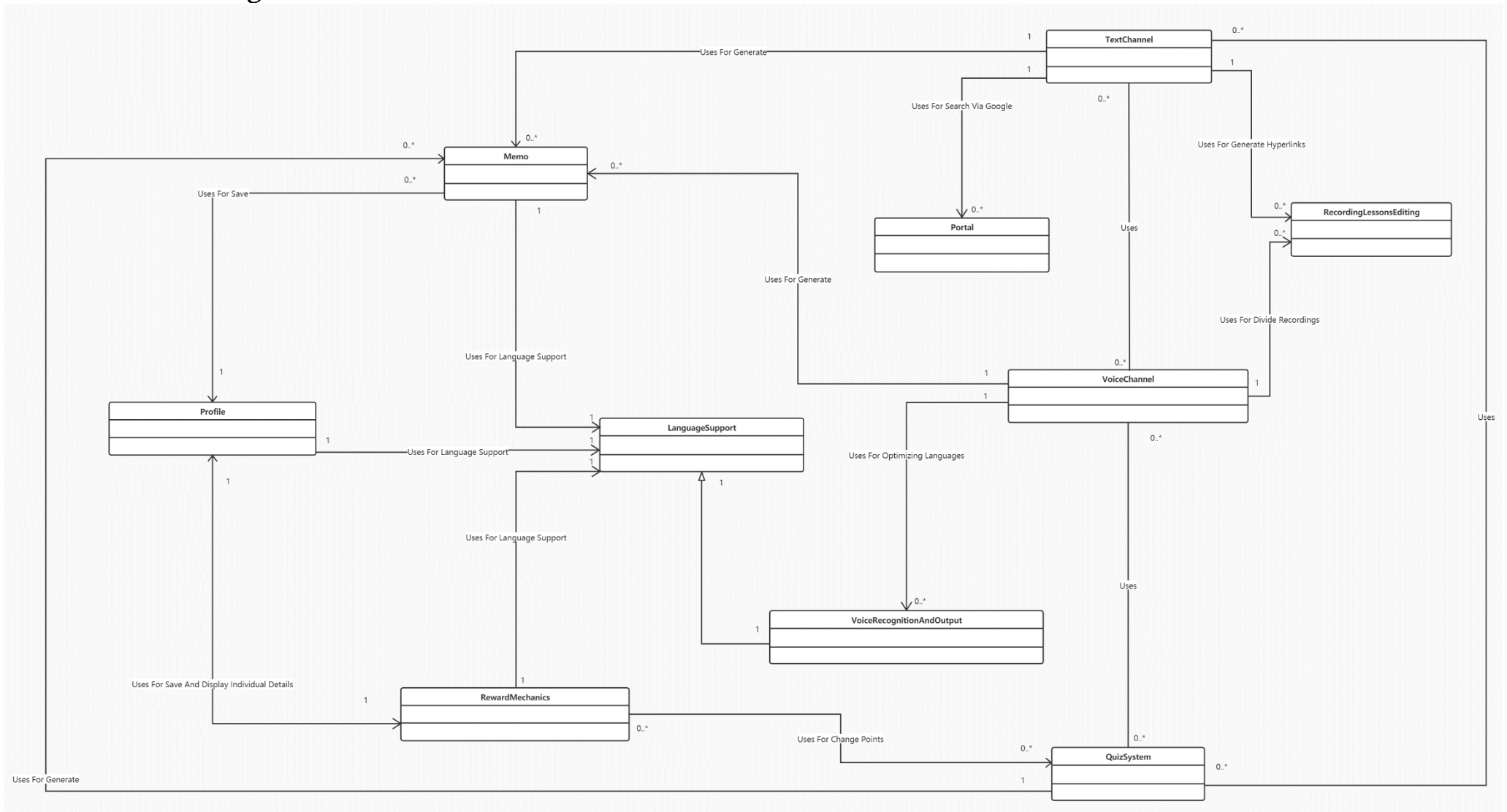
VoiceRecognitionAndOutput	
Responsibilities	Collaborators
Through voice recognition, generate specific language voice and subtitles (support multilingual display), and this function supports both live and recording.	LanguageSupport

Portal	
Responsibilities	Collaborators
The responsibilities of this class are performing a Google search on selected content at any time with you want.	

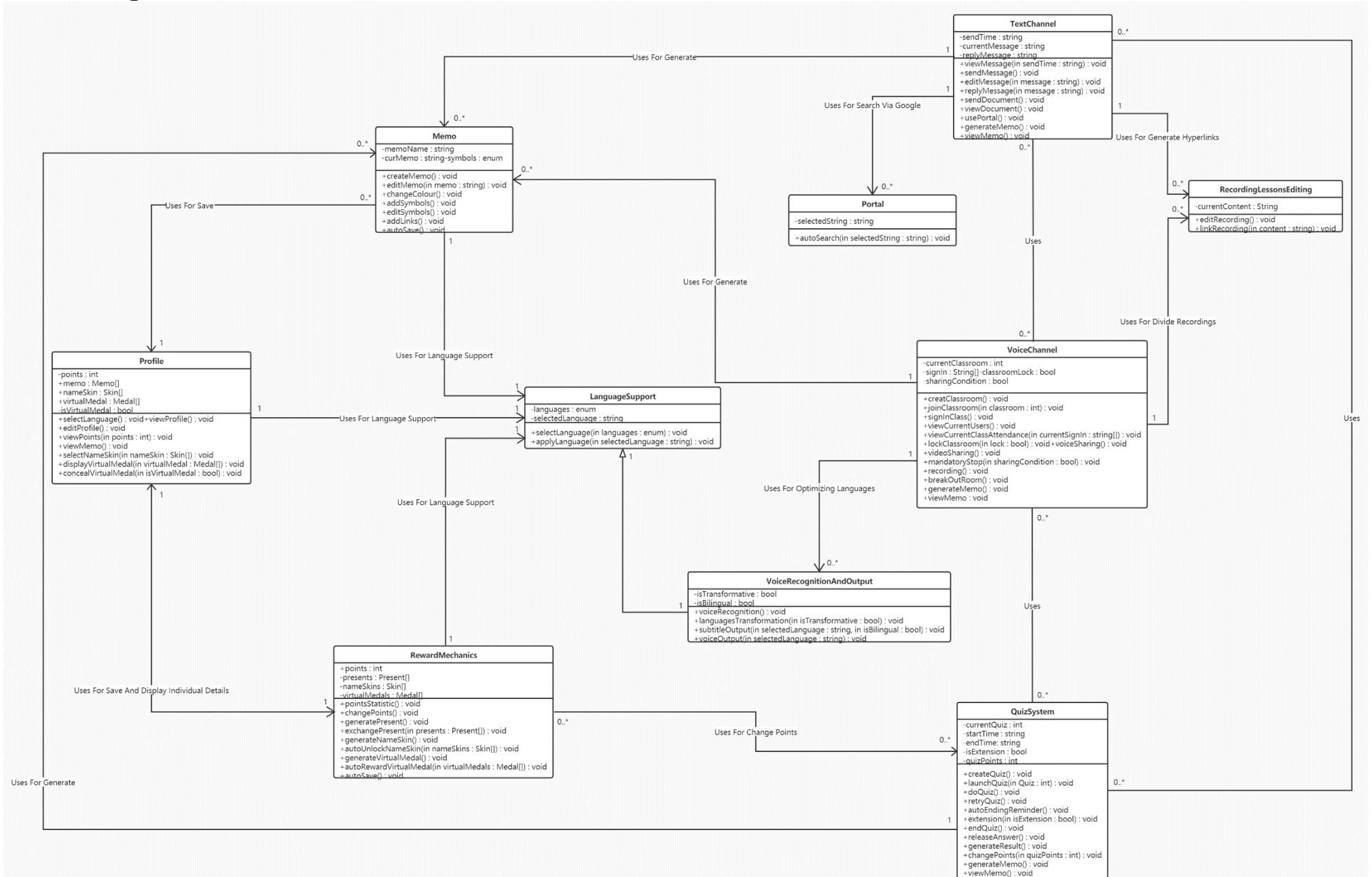
Memo	
Responsibilities	Collaborators
The responsibilities of this class are to provide users with editable memos anytime, anywhere and it will be stored in personal profile.	Porfile

RecordingLessonsEditing	
Responsibilities	Collaborators
The responsibilities of this class are to edited into corresponding parts according to the course materials, and users can click any course content to watch the corresponding recording lesson.	

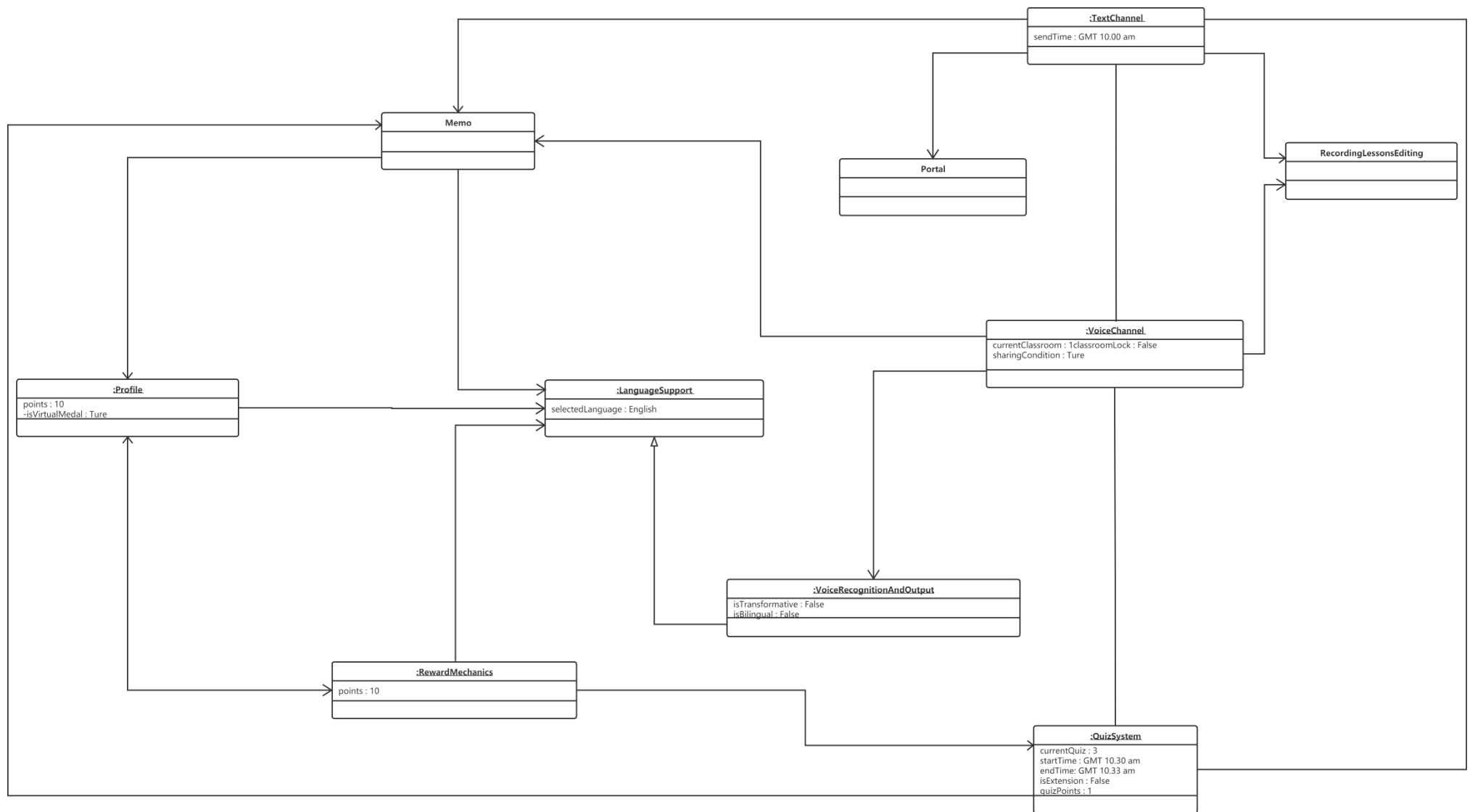
-First Cut Class Diagram



-Class Diagram



B6. Object Diagram (Launching live quiz – Other Classes Are Shown As Well But Are Not Active)

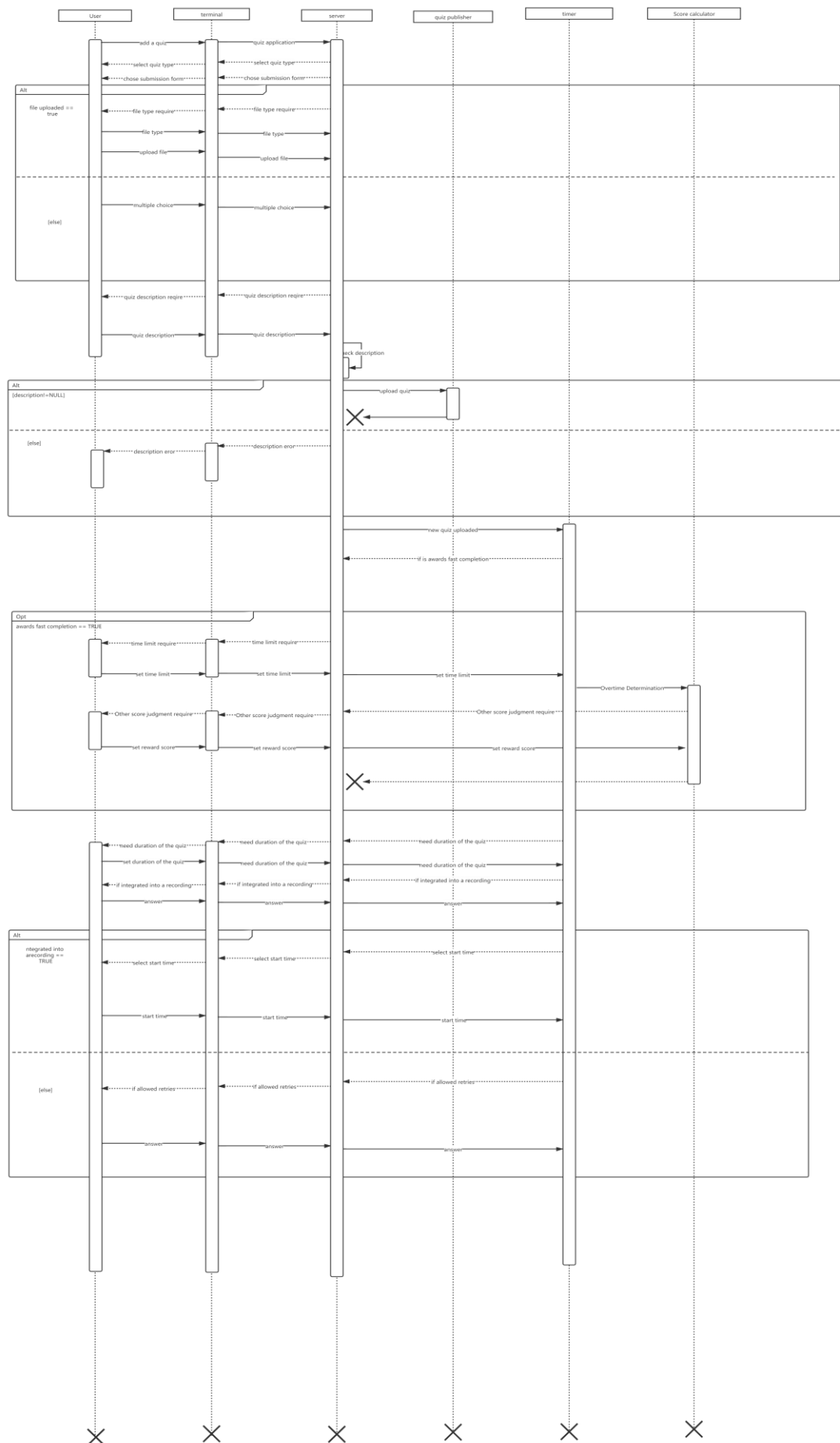


B7&8. Sequence and State Diagram

The following sequence diagram and state diagram show two non-trivial scenarios. The first one is the situation when the teacher has entered a created classroom and publishing quiz. The second is that any user has performed a right-click operation in a classroom, showing the user the memo and portal switch and following processes

1.Sequence Diagram

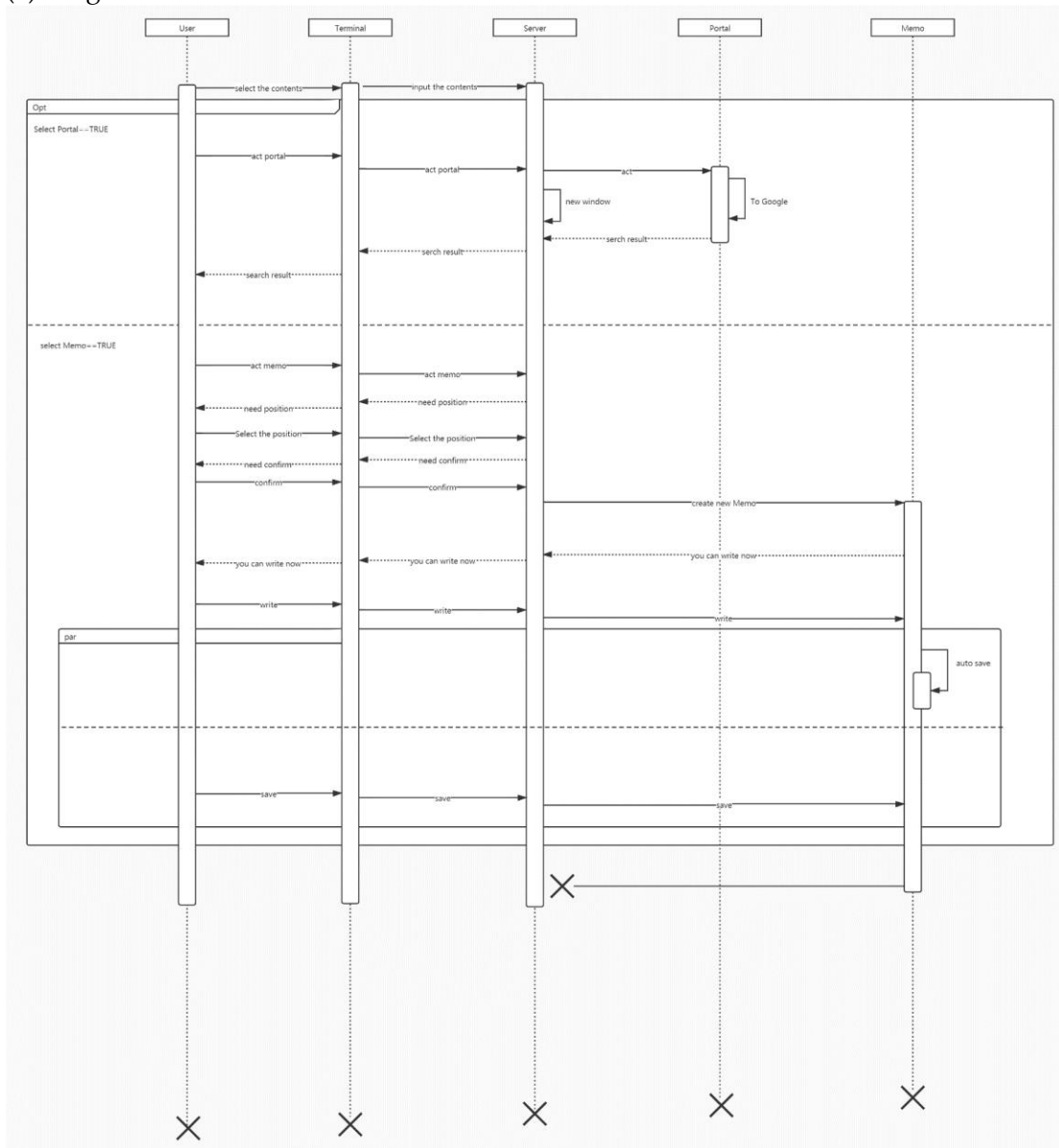
- (1) Assumption: A teacher has been entered a classroom and opened quiz option (which means the quiz channel has been initialized).
- (2) Diagram:



2.Sequence Diagram

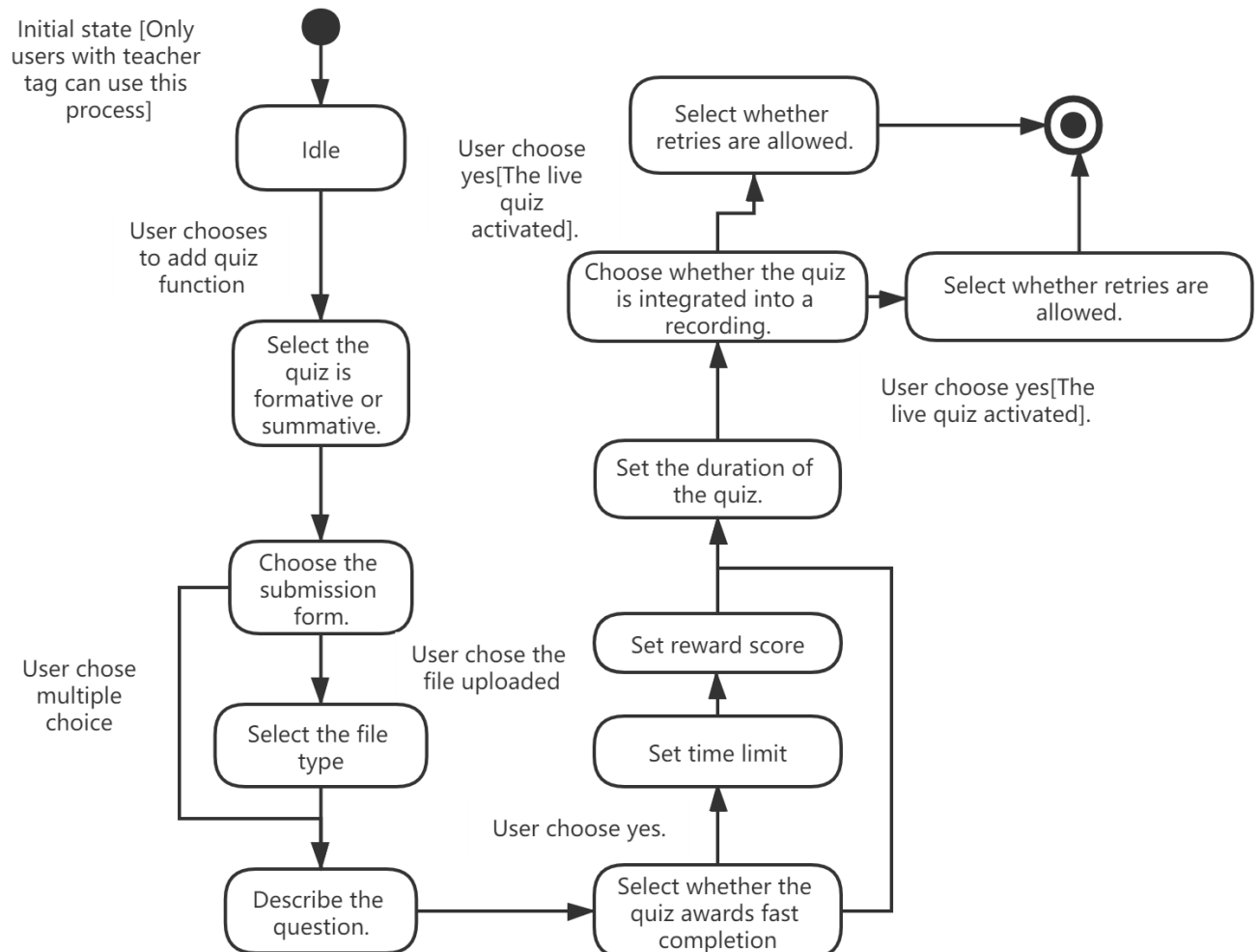
(1) Assumption: A user has been entered or assigned to a classroom.

(2) Diagram



1.State Diagram

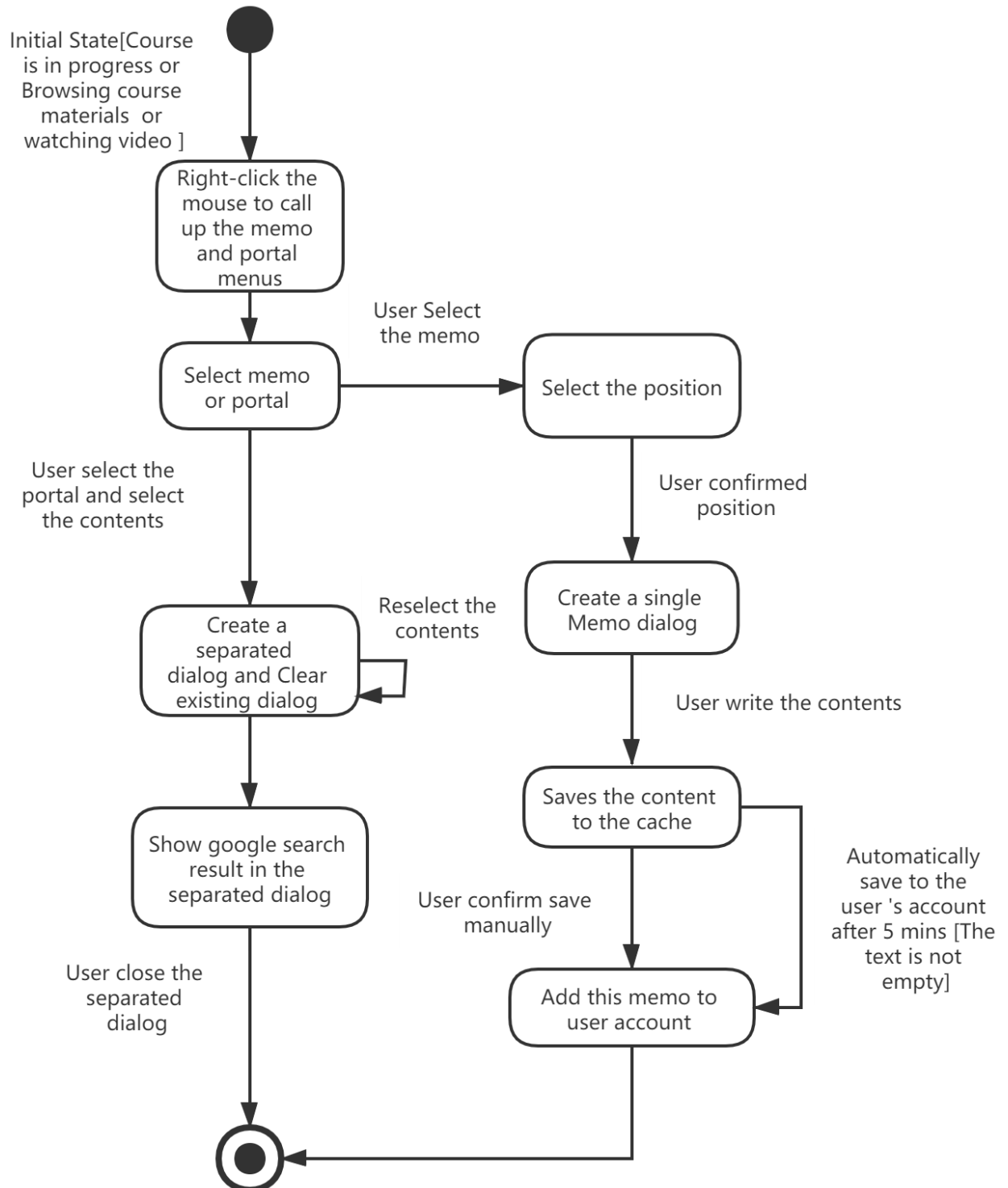
- (1) Assumption: 1. The user is the one with teacher tag
 2. The user has opened the quiz option, but quiz channel not started.



2.State Diagram

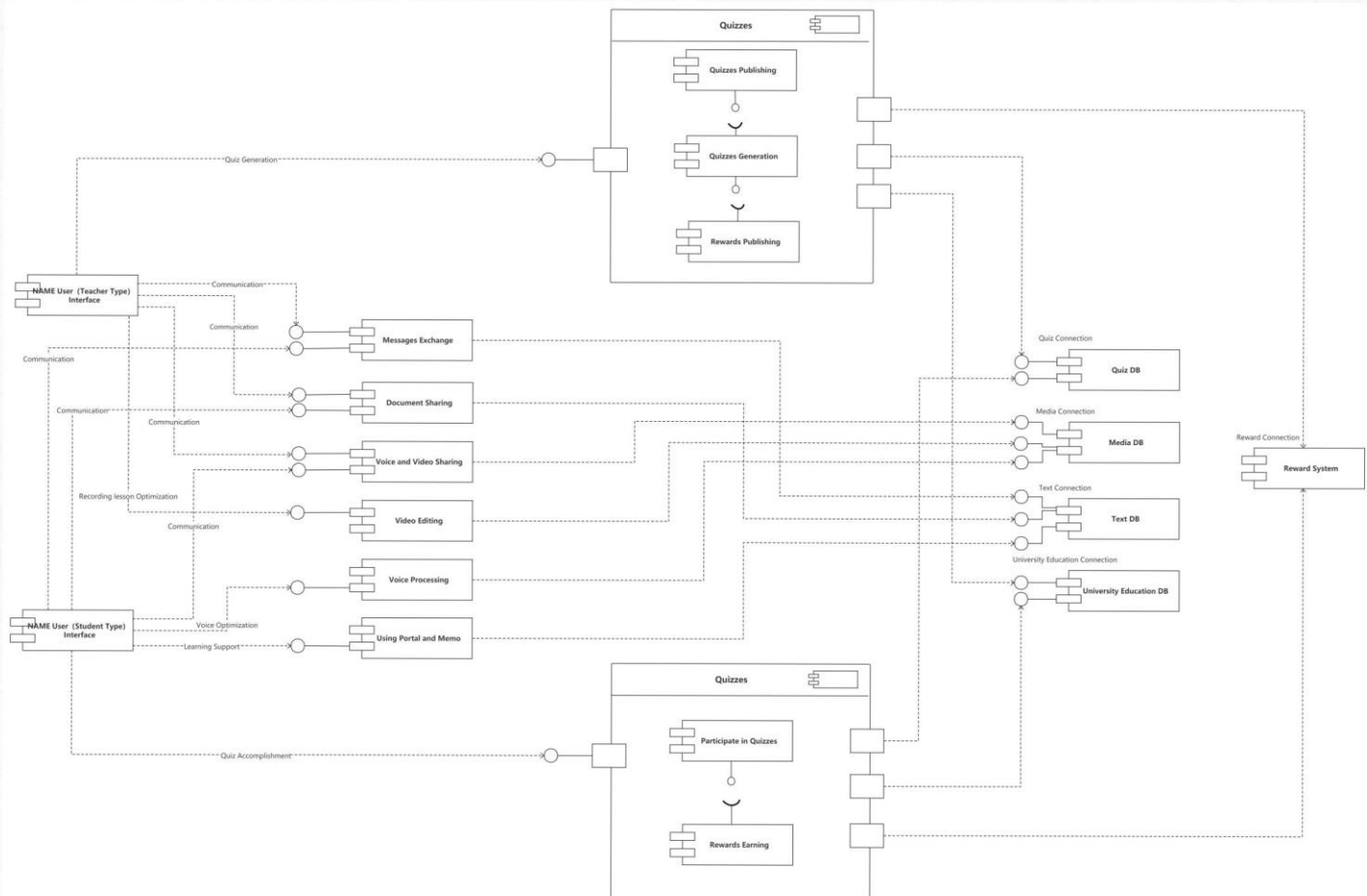
(1) Assumption: A user has been entered or assigned to a classroom.

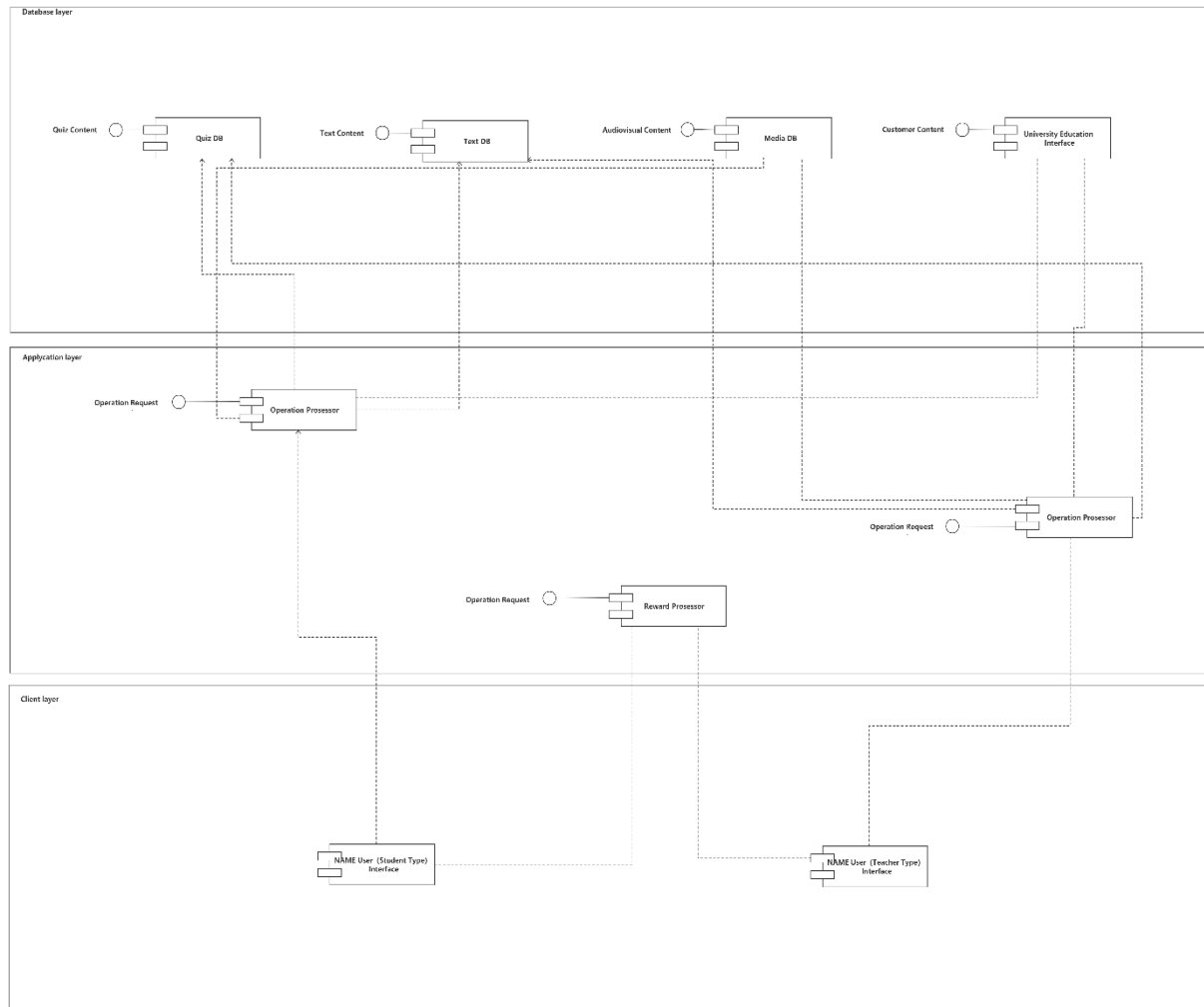
(2) Diagram



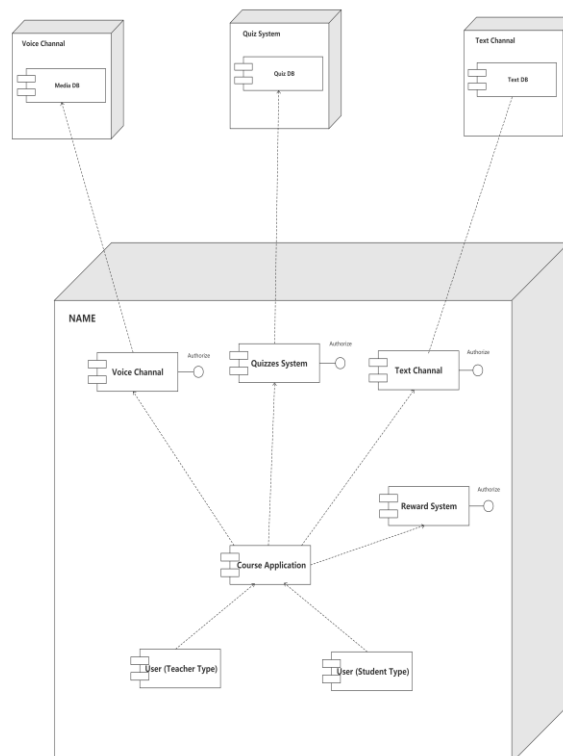
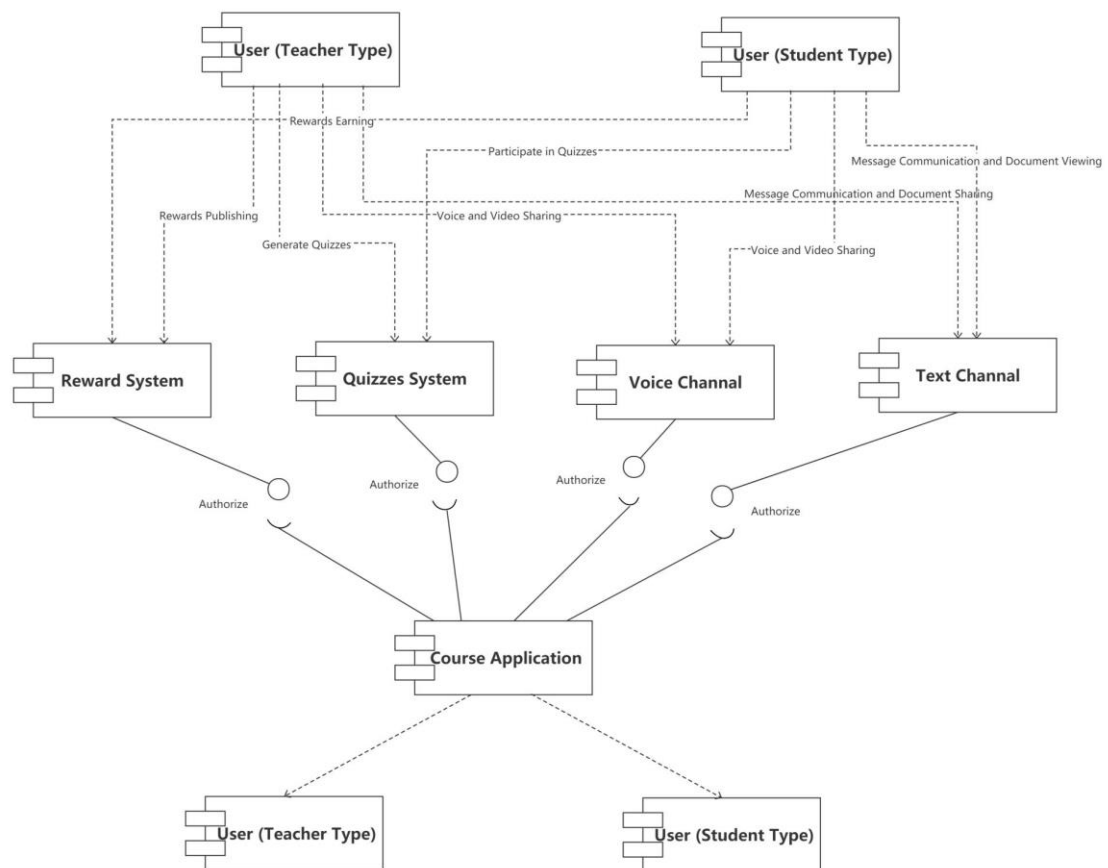
C. Software Architecture Style, Modelling and Evaluation

C1. The Component Diagrams and Deployment Diagrams with the layered Style





C2.Component Diagrams and Deployment Diagrams with the pipe and filter Style



C3. Architecture Analysis

The models we chose are Layered Style and Pipe and Filter Style.

Compared with the Pipe and Filter Style, the former has more abundant hierarchical distribution. In the former mode, each module can be derived to the most basic functions.

In terms usability, due to this deep and clear hierarchical division, in the first module, each function change has little impact on surrounding modules-layer changes affect at most two surrounding modules. The structure is clearer when people use it. For developers and maintenance work, the entire software consists of multiple separate parts, which are easier to repair when a problem occurs without affecting the overall operation of the software.

As far as security is concerned, in Layered Style we are divided into three layers: database, application, and client, and each layer is an independent part. When there is a problem in one link, we can ensure that the entire software will not crash. For example, when there is a vulnerability in the database, we can directly cut off the link between the database and the application to directly reduce the consequences to the minimum and fix it as soon as possible.

Our software has a live broadcast function and is the carrier of an online teaching platform. It has a lot of interactive functions. The smaller the impact of module changes on the module, the stronger the stability of the software

From this point of view, the feature of layered style is what we need.

Similarly, because of this division mode, we can call various functions flexibly in this mode as long as it is mentioned in the interface. Because of this, in this mode, the framework of the whole diagram will become very standard, and its library will be more abundant.

The latter has strong integration, each function will be classified into a large module, and then serve the whole software together.

This feature makes the hierarchy of software very clear, but the depth is very shallow.

Because of the too clear hierarchy and its integration, there is almost no data interaction between different modules, which is not conducive to our software, because in the process of live broadcasting, each module interacts and influences each other, and it cannot achieve the best effect by fighting on its own

Moreover, the strong integration means that we will have to shut down the server for major repairs when there is a problem. This is an increase in risk and workload.

To sum up, the layered style is more suitable for the software we designed.

D. Software Testing

-Introduction

The test object is an educational auxiliary software, which is introduced for the study activities during COVID-19. It provides functional and non-functional requirements in the scopes of the channels and systems of this software, and gives some reward mechanisms to improve the attentiveness of online study for students.

-Test items

The systems to be tested include the usability of applications both on PC and mobile devices, text channels, voice channels, reward mechanisms system and some functions of user-facing page for students. Besides, the back-end operations of live quiz system and disability help system will also be tested.

-Features to be tested

Features to be tested include the following:

Functional requirements:

1. As a student, logging into the system as a student
2. As a student, choosing the navigation bar
3. As a student, sending and receiving message in a group chat
4. As a teacher, sharing the screen for online session
5. As an admin, calculating points by reports
6. As an admin, sending reports to teacher
7. As an admin, matching rewards with points

Non-functional requirements:

1. As a student, choosing the user language
2. As a user (students and teachers), using UNICORN both on PC and mobile normally
3. As an admin, providing special service for disability

-Features not to be tested

The functions of editing recording lessons will not be tested, since we do not have enough data of recording lessons to use.

The functions of memo will not be tested, since it needs a huge amount of text data to test and we need other tools, which can test it automatically, to test it.

The functions of voice recognition will not be tested, since it needs a lot of voice data to test and we do not have this data temporarily.

-Approach

The quality team firstly allocates black-box and white-box test methods to each tester in the team, gives them the features of this software they need to test. Then each teammate completes the tests and records if the result of tests is "Pass" or "Fail". If the result is noted as "Fail", the bug reports will be sent to a corresponding developer, and the developer firstly use unit testing to test the particular functions and codes, fix bugs when some bugs occur. If the developer has changed some codes, he/she or the responsible tester need to use integration testing to confirm the change part combined well with other parts, after that it will be returned to the corresponding tester and be tested again. Also, the rate of pass of each feature will be noted. Finally, the test manager will check the pass rate of every single test case and the pass rate of all test cases to decide finish the test or not.

-Item pass/fail criteria

Test Cases Template

Project name:<UNICORN>

Group Number: <39>

Test Case ID	Test description	Test steps	Test Data	Expected result	Actual result	Pass /Fail	Text Comments
TD-10	Verify the login with valid user ID and password	Go to UNICORN Enter ID Enter Password Click Login	ID: test Password: ABC	User should be able to login			
TD-11	Verify the login with invalid user ID and valid password	Go to UNICORN Enter ID Enter Password Click Login	ID: test111 Password: ABC	User should not Login into UNICORN			
TD-12	Verify the login with valid user ID and invalid password	Go to UNICORN Enter ID Enter Password Click Login	ID: test Password: ABCDEFG	User should not Login into UNICORN			
TD-20	Match the chosen bar with actual page	Go to UNICORN Click Recordings	Domain: http://abc.com Recoding's domain:	User Enter the Recordings page			

			http://abc.com				
TD-21	Match the chosen bar with wrong actual page	Go to UNICORN Click Recordings	Domain: http://abc123.com Recoding's domain: http://abc.com	User Enter the Editor page			
TD-22	Match the chosen bar with error	Go to UNICORN Click Recordings	Domain: http://@#\$.com Recoding's domain: http://abc.com	Page indicates ERROR/404			
TD-30	Check user can send and receive messages successfully	Go to UNICORN Enter a group chat Type message Send message Get response	Type "Hello" Send "Hello" Receive "Good morning"	USER send correct message and get reply			
TD-31	Check user cannot send but cannot receive messages	Go to UNICORN Enter a group chat Type message Send message No response	Type "Hello" Fail on Sending (No response)	User cannot send messages successfully			
TD-40	Share the teacher's screen for all students	Go to UNICORN Enter an online session Click Sharing	Share to all students Using amount of virtual student id Check	All students can see the shared screen			
TD-41	Share the teacher's screen unsuccessfully	Go to UNICORN Enter an online session Click Sharing	Share to all students Using amount of virtual student id Check No accounts can see it	Error on connecting No students can see the shared screen			
TD-50	Compare the true point	Go to UNICORN	True point: 1+1=2	Get students' correct points			

	with correct calculated one	Find reports Collect points Calculate points	Calculated point:1+1=2				
TD-51	Compare the true point with wrong calculated one	Go to UNICORN Find reports Collect points Calculate points	True point:1+1=2 Calculated point:1+123455 =123456	Get students wrong points Mistakes on ranking and rewards			
TD-60	Verify the correct student ID on report with matched ID with name	Go to UNICORN Get reports Get ID on coverage Compare ID from storage	Student ID in storage: 123 Student ID on coverage of report: 123	Send the proper report to teachers			
TD-61	Verify the wrong student ID on report with matched ID with name	Go to UNICORN Get reports Get ID on coverage Compare ID from storage	Student ID in storage: 123 Student ID on coverage of report: 456	Send improper report to teachers Wrong on marking			
TD-70	Use 100 points to match reward "Jelly"	Go to UNICORN Click on Rewards Click on 100 points Exchange "Jelly"	Match points 100 points = Jelly 200 points = Apple ...	Students can get "Jelly"			
TD-71	Use 100 points to match reward "Apple"	Go to UNICORN Click on Rewards Click on 100 points Exchange "Jelly"	Match points 100 points = Jelly 200 points = Apple ...	Students cannot get "Apple"			
TD-80	Choose System Language "Spanish"	Go to UNICORN Click on Settings Click on	Chosen Language System Language	The System Language has changed to wanted			

		Language Click on Spanish	now: Spanish	language			
TD-81	Choose System Language "French"	Go to UNICORN Click on Settings Click on Language Click on Spanish	Chosen Language System Language now: Spanish	The System Language has changed to an improper language			
TD-90	Use UNICORN with a mobile phone (under good connection with network)	Go to UNICORN Login Click on Bar at bottom randomly Click on links inside randomly	Chosen page: Editor Page Actual Page: Editor Page	UNICORN can work well with a phone			
TD-91	Use UNICORN with a PC (under good connection with network)	Go to UNICORN Login Click on Bar at bottom randomly Click on links inside randomly	Chosen page: Editor Page Actual Page: Assignment Page	UNICORN can work well with a PC			
TD-92	Use UNICORN with a mobile phone (under good connection with network)	Go to UNICORN Login Load pages	Load pages fail Cannot show pages	UNICORN cannot work on a phone			
TD-93	Use UNICORN with a PC (under good connection with network)	Go to UNICORN Login Load pages	Load pages fail Cannot show pages	UNICORN cannot work on a PC			
TD-100	Call UNICORN to read Words	Go to UNICORN Speak "Read	Words on Page: 123 UNICORN	UNICORN is friendly to blind people			

	on pages (for blind)	this page"	reads:123				
TD-110	Call UNICORN to read Words on pages (for blind)	Go to UNICORN Speak "Read this page"	Words on Page: 123 UNICORN cannot recognize the command and do nothing	UNICORN cannot be used for blind people			
TD-110	Compare the subtitle on recording pdf part with actual words on pdf (for hearing impairment)	Go to UNICORN Click on Recordings Select a recording Add subtitles Calculate the Coincidence rate of pdf part with the corresponding pdf	Coincidence rate= 80%	UNICORN is friendly to hearing impairment people			
TD-120	Compare the subtitle on recording pdf part with actual words on pdf (for hearing impairment)	Go to UNICORN Click on Recordings Select a recording Add subtitles Calculate the Coincidence rate of pdf part with the corresponding pdf	Coincidence rate= 40%	UNICORN cannot be used for hearing impairment people			

-Exit criteria

The pass rate of all test cases should be higher than 95%, and the pass rate of single test case should be higher than 95%.

-Assumptions

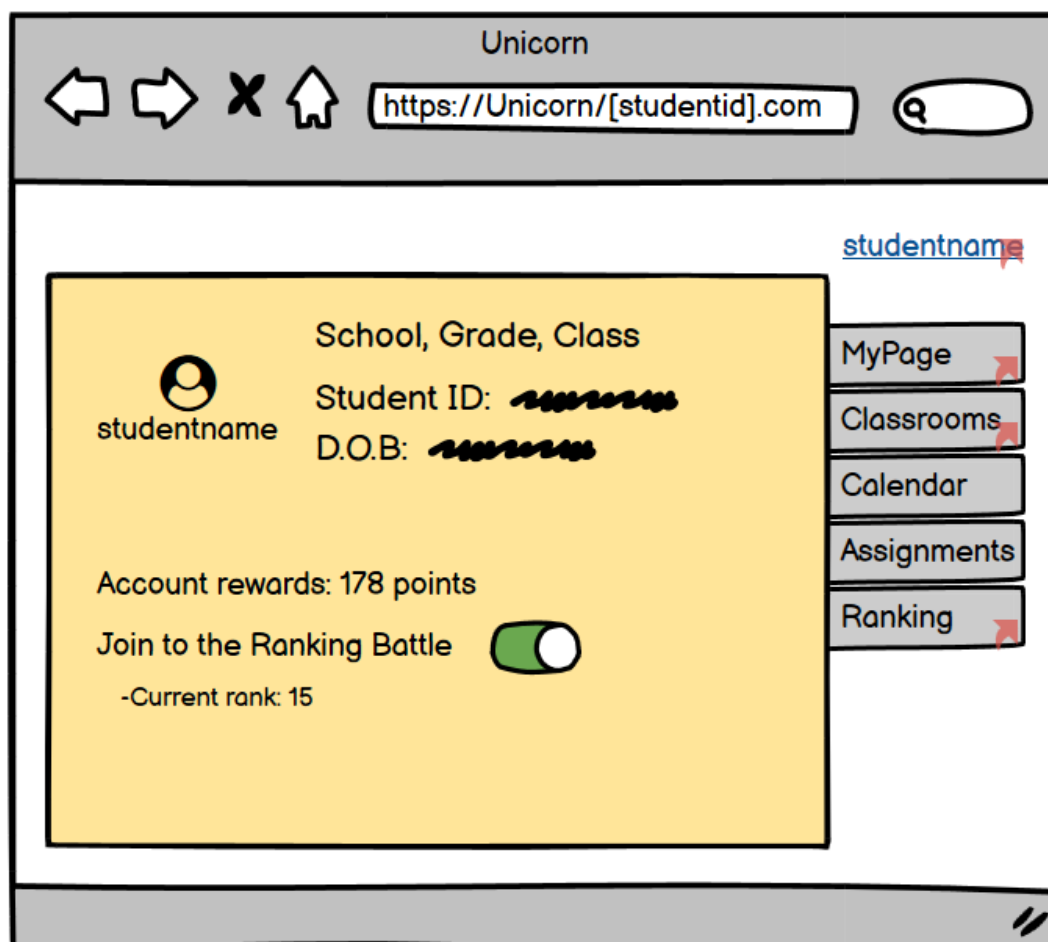
The following are some assumptions of this testing plan.

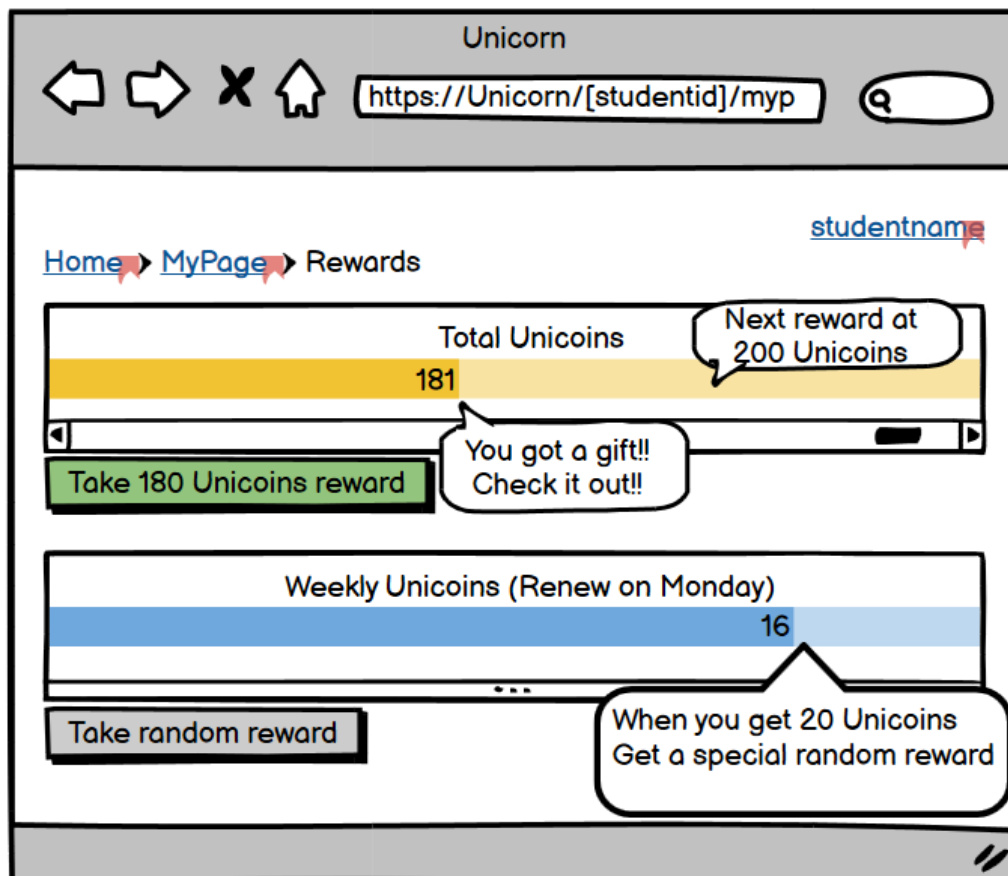
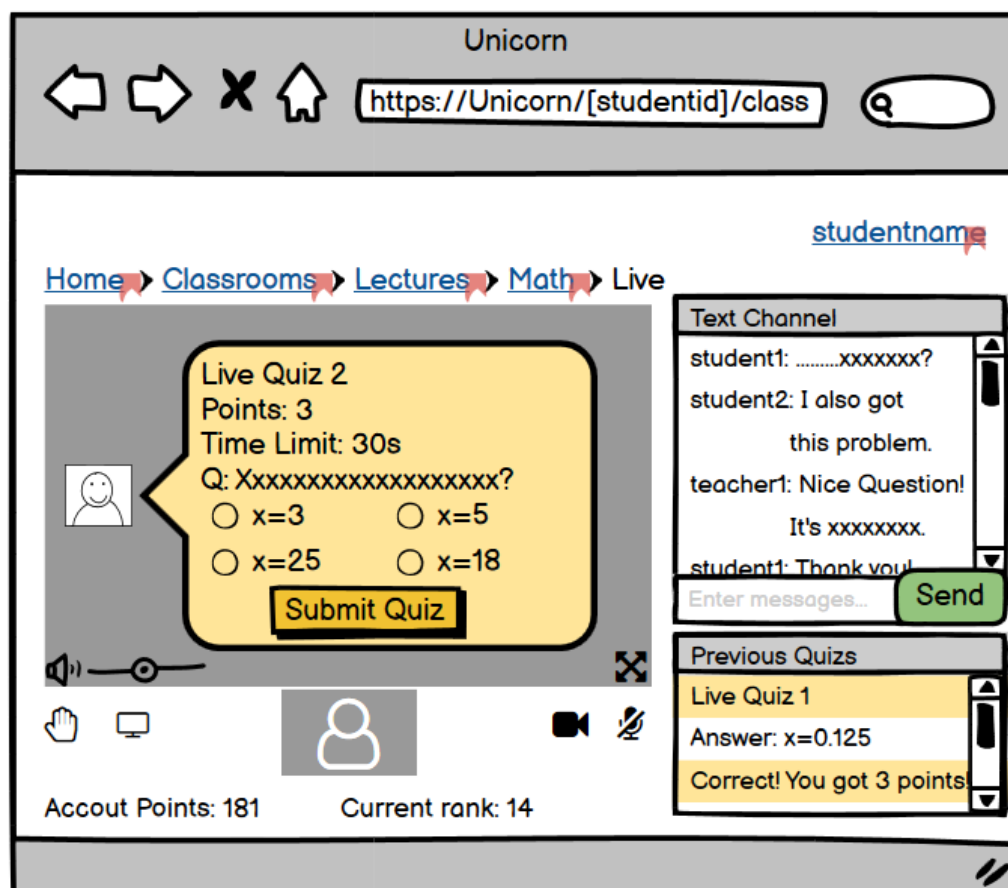
If all the tests pass, the quality team still need to receive the bug reports from the users of this software and fix these bugs by using the approach provided above.

After all pass rates are higher than 95%, the test manager makes the final decision on whether to finish the test, though the pass rate is higher than 95%. Because some particular functions are required to have a higher pass rate.

E. Usability Testing

E1. Interactive prototype





Unicorn

https://Unicorn/[studentid]/ranki

studentname

[Home](#) ➤ Ranking

🏆 Student1	220 points
★ Student2	212 points
☆ Student3	210 points
Student4	205 points
Student5	202 points
Student6	198 points
Student7	193 points
Student8	188 points
Student9	185 points
Student10	183 points
Student11	182 points

Unicorn

https://Unicorn/[studentid]/myp

studentname

[Home](#) ➤ [MyPage](#) ➤ [Edit Process](#) ➤ Edit Page

System Reminding

Are you sure you want to export this video?

C:\Math\lectures

No Yes

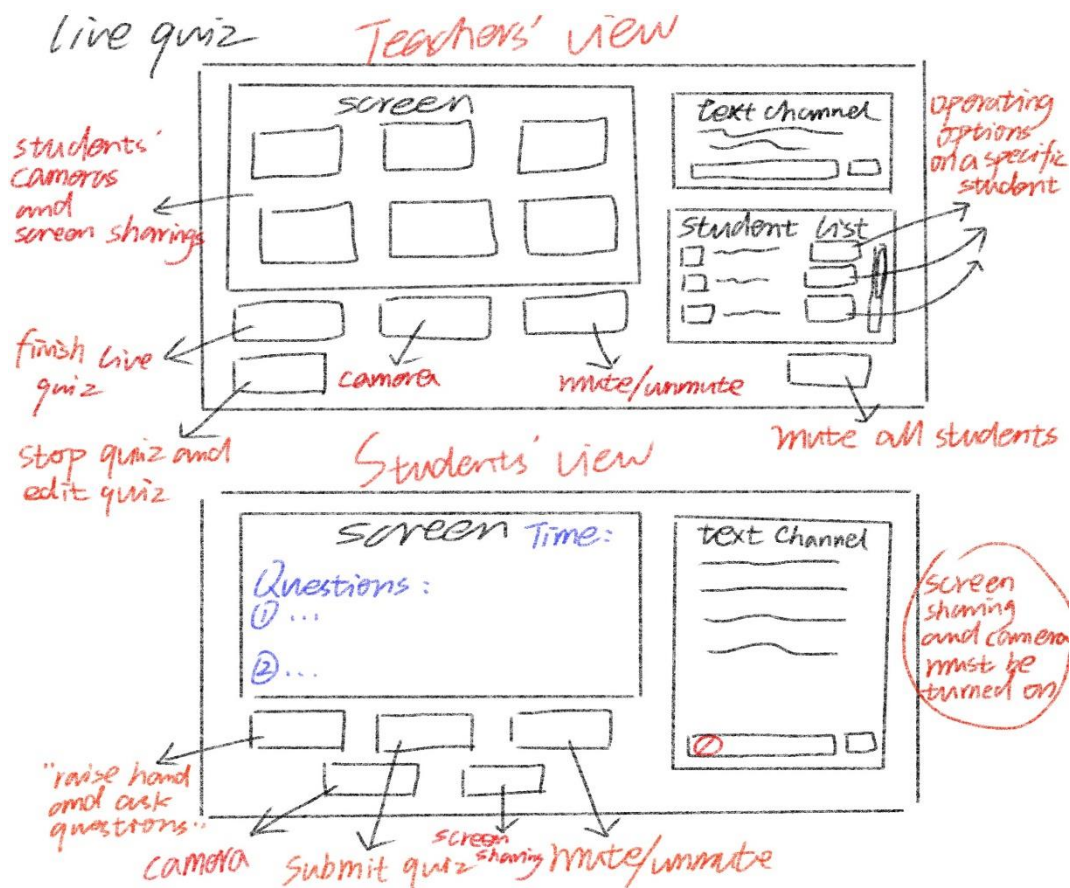
☒ Auto-generate subtitles

⏮ ⏪ ⏩ ⏭ 🔍 ⏴

+
Text
Add Text Lable

+
Audio
Add Extra Audio

+
PIP
Import Image or Video



The first advantage of UNICORN is that it can be used for all-age student. Just set the rewards differently (e.g. snacks for teenagers, small part of final marks for unis), all students will join the system actively. Secondly, the system is convenient to expand, every function we have now is clearly, once we received some suggestions on optimizing, we can easily add a new function or just fix the present one. Thirdly, our system is safe. Every account on UNICORN is associated with the specific school id and the password is set by each student/teacher themselves. And also, all uploaded files, and comments will be checked by the admin before releasing. At last, the system will confirm the ID whether it belongs to a teacher or a student, and load the relevant link to the users (which means the pages for teachers and students are different), so it is pleasuring to use UNICORN.

E2. Video Recording

Check from the MP4 file.

F. Ethics and Professional Practice

The ‘Unicorn’ is a helpful software that helps a teacher educate the students efficiently and supports students to study more effectively during pandemic like COVID-19. Given that primary purpose of Unicorn is to improve the quality of education of the public, the software is consistent with the aims of Principles 1.1. When designing and building the software for the application, the developers at Unicorn noticed that they had several principles such as safety of user’s information and invasion of privacy. From an ethical point of view, the developers at Unicorn consider ethical questions within following principles of ACM Code of Ethics.

Basically, Unicorn requires the user’s personal information for identification. Therefore, Unicorn stores all users’ personal information because of the user’s identification. Accordingly, Unicorn demonstrated a commitment to Principle 1.2 by using the symmetric algorithm to encrypt all users’ personal information. However, as Voice Channel progressed in real time, Principle 1.2 suggests that Unicorn should have included abusive language detection system and a blocking system against harmful images. Principle 1.7 calls for extraordinary care even though Unicorn has security policy includes a ban on screenshots and compatibility with screen sharing apps, given that Voice Channel with educational materials from teacher users are automatically recorded and student users can edit them themselves.

Unicorn complies with principle 2.1. by communicating transparently with colleagues, informing all possible harm in advance and updating periodically after development completion to minimize client and user harm. When designing and building the Unicorn, we actively give or receive feedback from colleagues and professors, complying with Principle 2.4. In accordance with Principle 2.3, we abide by the laws in all processes related to the development of the Unicorn. Portal functionality provided for the convenience of education can raise concerns about Principle 2.8. Furthermore, we also ensure that the Unicorn respect the users’ work, in regard to Principle 1.5. To protect user’s creative and innovative works, Unicorn should prevent the abuse of resources. So, we ensure that all resources that user provide will be used to improve the quality of education.