



Voice Campus

Team 6

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Software Requirements Specification Document

Date: 2021. 04

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1. Introduction

1.1. Purpose

The document is a Software Requirement Specification for Voice Campus (Blind-Friendly Learning Application) project. Main readerships of the document are system end-user, software developers from Team6, and the expected partner Xinics (LearningX). To fulfill the document's purpose for all the readerships, the document includes both user requirements and system requirements.

In the user requirement, the document indicates services of the system and its operational constraints using natural language to deliver clear messages. In the system requirement, the document includes systematic requirements and operational constraints. System requirement states a clear image of what should be implemented in the system, and thus will be read in the actual development and utilized in the contract.

1.2. Scope

The Voice Campus system is a learning aid application for students with visual impairments. One of the biggest inconveniences visually impaired students may experience when studying is that they cannot read a textbook consisting of type. To help alleviate this inconvenience, we provide visually impaired students with text-to-speech and test assistance. This system is based on the UI familiar to visually impaired people and TTS and STT functions using open source to make VA functions easier to use.

Above all, we hope that this application will help students with visual impairments to solve a little bit of the difficulties they face while studying in college.

1.3. Definitions, Acronyms, and Abbreviation

[Table 1] Table of acronyms and abbreviations

Acronyms & Abbreviations	Explanation
VA	Voice Assistance service, Android's voice assistant and iPhone's voice over
TTS	Text To Speech
SST	Speech To Text
RAM	Random Access Memory

JSON	JavaScript Object Notation
OS	Operating System
SRS	System Requirement Specification
API	Application Programming Interface
UI	User Interface
HTTP	Hypertext Transfer Protocol
TA	Teaching Assistance

Table 1 Table of acronyms and abbreviations

1.4. References

- (1) AOSP Java Code Style for Contributors, Android, Last modified at 2021, <https://source.android.com/setup/contribute/code-style#follow-field-naming-conventions>
- (2) API Design Guidelines, Swift, <https://swift.org/documentation/api-design-guidelines/>
- (3) Canvas LMS - REST API and Extensions Documentation. (n.d.). Retrieved April 23, 2021, <https://canvas.instructure.com/doc/api/>

1.5. Overview

The remainder of the document consists of three sections: section 2, section 3, section 4. Among them, section 2 and section 3 are the core contents of this document.

Section 2 is the overall description of Voice Campus. It describes features that will be implemented in the Voice Campus. After you read the section, you can imagine how the Voice Campus will work. In particular, customers and potential users should pay attention to this section.

Section 3 is the specific requirements. This section is a detailed description of the requirements that must be followed to create a Voice Campus, which will be a direct reference when developing.

Therefore, it is a part that developers should pay particular attention to.

Section 4 is meta information about the document. Most readers do not need to pay attention to this section.

Explaining the structure of SRS is done. Please refer to it for your reading.

2. Overall Description

2.1. Product Perspective

This product is designed for certain students with visual impairments. This application will make it comfortable for those people to take online classes and tests, so that they can adapt to their university life more easily. This application is an application that values consideration for the socially disadvantaged and will have great significance in contributing socially.

2.1.1. System Interfaces

The information of users and courses are connected to the storage of Sungkyunkwan University Portal's account. User's log record of activity on the Voice Campus such as login, taking an exam will be stored using firebase. User's record of using STT will be stored in the user's local area using SQLite.

2.1.2. User Interfaces

An interface is provided through the screen of the mobile phone, and information can be input through touching, pressing or taking a certain gesture.

2.1.3. Hardware Interfaces

The system is intended for Android mobile phones. The mobile phone must have at least 1GB RAM and 1.0 GHz single processor.

2.1.4. Software Interfaces

The system is intended for Android OS version at least Android 6.0 (API 23) and targeting Android 10 (API 29).

2.1.5. Communications Interface

User device and server communicate with HTTP protocol in JSON format.

2.1.6. Memory Constraints

The system should run on mobile devices with least 2GB RAM for primary memory and the system requires at least 512 MB for installation and execution.

2.1.7. Operations

2.1.7.1. User

- Login
 - Users can login by account linkage with LearningX application
 - portal ID and password is connected to the Sungkyunkwan University portal.
- To-do list
 - Users can check unfulfilled attendance, assignment and test and move directly to the corresponding content.
- Test
 - Users will be able to take quizzes or exams with the assistance of TTS and STT
 - Four types of test will be supported.
- File translation
 - User can select voice-translated files(PDF, PPTX, DOCX, HWP) that he wants to listen to or translate a new file
- File Play
 - Users can check unfulfilled attendance, assignment and quiz and move directly to the corresponding content.

2.2. Product Functions

2.2.1. Login

After the user downloads our application, users have to login to the system. After filling required fields with ID and password, users can login to the system using the login button. After login to the system, the user can use an approach to the functions of VOICE CAMPUS.

2.2.2. Looking up an assignment list

On this page, users' unfulfilled assignments are displayed on the screen. Users can move to the corresponding contents directly. The unfulfilled assignment list is sorted by the deadline and all the information including the name of the courses is displayed vertically. When the user fulfills the assignment, the LearningX server updates the list.

2.2.3. Test

In this page, users will be able to take quizzes or exams. When a user enters the certain exam page, description and type of the exam will be informed by sound. There are four types of exam: multiple choice, list, writing essay, fill in the blanks. Users can start exams using the start exam button. Users can answer multiple choice problems by sound and gesture. Also, users can answer short/essay problems by STT service and answers written by STT are recorded. When the user goes to the next question, the answers are sent to the server and recorded data will be saved. If the exam is over, the data is sent to the professor or TA by LearningX message system.

2.2.4. File translation

In this page, a user can select voice-translated files(PDF, PPTX, DOCX, HWP) he wants to listen to or translate a new file. User can translate a new file by touching the ‘translate new file’ button, and when he clicks it a file manager will be opened and the user can choose a file. A list of files that have been already translated will be displayed below the button.

2.2.5. File Play

In this page, users are able to listen to PDF, PPTX, DOCX, HWP file’s contents by touching the play or pause button. Also, users can make voice memos using the memo button. If users want to make a memo, a voice file will be paused and can record their voice.

Users can select a page to listen or set the speed. Furthermore, they can set whether to listen to only one page or consecutive pages by clicking the ‘consecutive listening’ button.

Users can hear their voice memos only, or with file’s contents by clicking the ‘only memo listening’ button.

2.2.6. Video Play

A user can play an LearningX lecture video via video player. He can rewind 10 seconds, play or pause the lecture video, go to 10 seconds forward, and set play speed 0.25x to 2.0x by pressing several buttons on the screen.

2.3. User Characteristics

2.3.1. System Administrator

System administrator is limited to those who have an appropriate right to access LearningX applications or information of SKKU student’s data. Also, he must have sufficient knowledge and

capabilities to deal with system management and problems. In addition, he has to major in computer science or similar studies, so that he can deal with the parts where knowledge of networking, database and consistent development is required.

2.3.2. User

The user is generally referred to in this document as a student who is visually impaired. User is assumed to be an SKKU student and has the ability to listen Korean or English well. And it is assumed that users are accustomed to deal with mobile applications which are composed of pressing, taking a gesture etc.

2.4. Constraints

The following constraints should be met when developing the system.

- Use open source software if available
- Use well-known open sources to avoid inevitable errors
- Decide in a more blind-friendly direction
- Avoid complex, visually dependent UI
- Develop UI based on VA service
- Optimize the source code to prevent waste of system resources
- Consider future maintenance and readability of code
- Develop with Windows 10 environment and Webstorm build 211.6693.108 using React Native
- Support minimum Android version 6.0 (API 23) and target Android version 19 (API 29)
- minimum IOS version 11.0 and target IOS version 14.4.2.
- Test the system using Android version 10 (API 29) and IOS version 14.4.2.

2.5. Assumptions and Dependencies

All systems in this document are written on the assumption that they are designed and implemented based on Android/IOS devices. The systems are developed based on the Android minimum API version 23, IOS version 11.0 and may not be applied to other operating systems or versions. The application is assumed to always run with VA function.

3. Specific Requirements

3.1. External Interface Requirements

3.1.1. User Interfaces

[Table 2] Basic User Interaction Using Touchscreen

Name	Basic User Interaction Using Touchscreen
Purpose/Description	Users input their intention with their mobile device. All the inputs should be depicted largely and only the buttons users really need should be on the screen.
Input source/ Output destination	User's touch screen / User's mobile device
Range/ Accuracy/ Margin of error	Range according to the number of buttons on the screen / Accuracy according to the accuracy of touch from users/Margin of error of touch sensitiveness
Unit	A touch
Time/ Velocity	Asynchronous user input / Instant execution of a user instruction
Relationship with other input/outputs	After receiving the inputs from the user, the device transmits the data to the server for processing the input data to get desired output data
Format and configuration of screen	1. An activity screen connected to an XML file 2.All the texts are inside of the box to be recognized as one object and are large in size. 3. Users click a desired button to interact with the system
Format and configuration of window	N/A
Data type	Int type value of a button code

Instruction type	Instruction mapping according to the value of a button code
Exit message	N/A

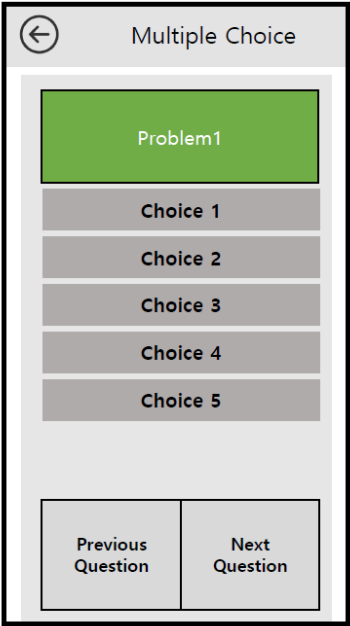
[Table 3] Unfulfilled assignments interface

Name	Unfulfilled assignments interface
Purpose/Description	Users' unfulfilled assignments are depicted on the screen. Users can move to the corresponding contents directly
Input source/ Output destination	LearningX server / Client
Range/ Accuracy/ Margin of error	N/A
Unit	Entities (unfiled assignments)
Time/ Velocity	Asynchronous user input / Instant execution of a user instruction
Relationship with other input/outputs	When the user fulfills the assignment, the LearningX server updates the list.

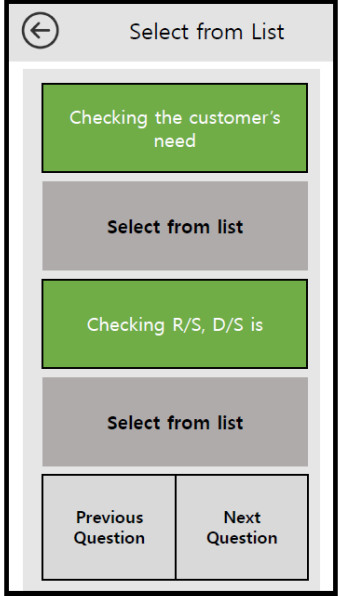
Format and configuration of screen	<ol style="list-style-type: none"> 1. An activity screen connected to an XML file, mainly composed of TextViews 2. Unfulfilled assignment list is sorted by the deadline. 3. All the information including name of the classes is placed vertically 	
Format and configuration of window	N/A	
Data type	Int type value of a button code	
Instruction type	Instruction mapping according to the value of a button code	
Exit message	N/A	

[Table 4] Test Interface 1 – Multiple choice problem


Name	Test Interface 1 – Multiple choice problem
Purpose/Description	Interface for problems that require to select one of the multiple choices. The user can browse the question and problems in order and answer the problems.
Input source/ Output destination	N/A

Range/ Accuracy/ Margin of error	N/A
Unit	Screen
Time/ Velocity	Time which the user starts to take a test/ During the user take all test or the limited time of the test
Relationship with other input/outputs	N/A
Format and configuration of screen	<ol style="list-style-type: none"> 1. User is informed about the problem type by sound. 2. The problem is divided into two parts: describing the problem and selecting correct answers. 3. Each selecting line view contains a single line of question. 4. When line view is focused by VA, the description is spoken by VA's TTS. 5. When the answer view is focused by VA, the user can hear and select the answer. 
Format and configuration of window	N/A
Data type	Text, sound, integer
Instruction type	Sound
Exit message	N/A

[Table 5] Test Interface2 – Select from list problems


Name	Test Interface2 – Select from list problem
Purpose/Description	Interface for problems that require multiple select from list answers inside the question. The user can browse the question and problems in order and answer the problems.
Input source/ Output destination	
Range/ Accuracy/ Margin of error	N/A
Unit	Screen
Time/ Velocity	When user takes test / Duration of the test
Relationship with other input/outputs	N/A
Format and configuration of screen	<ol style="list-style-type: none"> 1. User is informed about the problem type by sound. 2. The problem description is divided into lines and answer views in order. 3. Each line view contains a single line of question. 4. When line view is focused by VA, the description is spoken by VA's TTS. 5. When the answer view is focused by VA, the user can hear and choose the answer. 6. Users can either go to previous or next question. Then the answers are sent to the server. 
Format and configuration of window	N/A
Data type	Text, sound, integer
Instruction type	Sound
Exit message	N/A

[Table 6] Test Interface3 – Essay problem

Name	Test Interface3 – Essay problem
Purpose/Description	Interface for problems that require writing an essay in the blank answers inside the question. The user can browse the question and problems in order and answer the problems.
Input source/ Output destination	-
Range/ Accuracy/ Margin of error	N/A
Unit	Screen
Time/ Velocity	Time which the user starts to take a test/ During the user take all test or the limited time of the test
Relationship with other input/outputs	N/A
Format and configuration of screen	<ol style="list-style-type: none"> 1. User is informed about the problem type by sound. 2. The problem description is divided into problems and blank for writing essays. 3. When the line view of a problem is focused by VA, the description is spoken by VA's TTS. 5. When the written answer view is focused by VA, the user can record his answer and fill in the essay blank by using STT. 6. Users can either go to previous or next question. Then the answers and recorded files are sent to the server. 
Format and configuration of window	N/A
Data type	Text, sound, integer
Instruction type	Sound

Exit message	N/A
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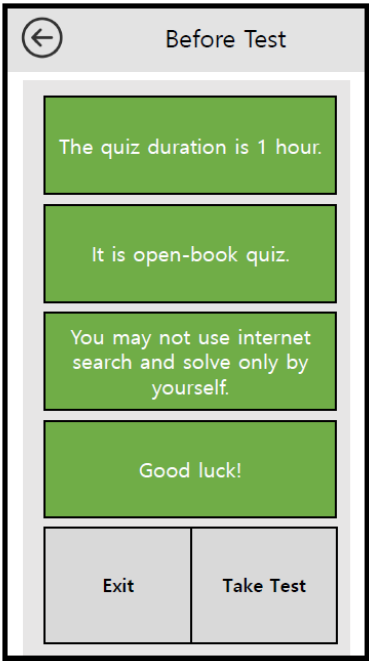
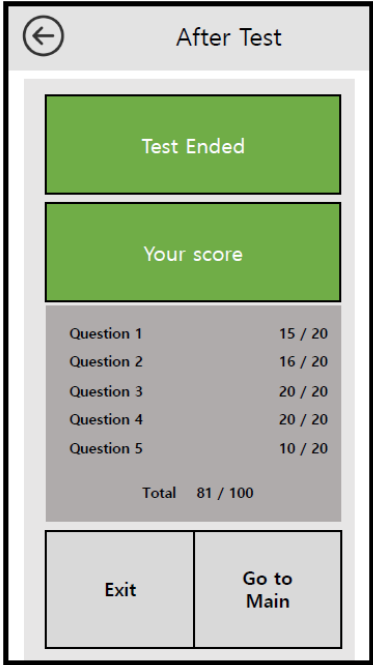
[Table 7] Test Interface 4 – Fill in the blanks problem

Name	Test Interface 4 – Fill in the blanks problem
Purpose/Description	Interface for problems that requires multiple filling in the blank answers inside the question. The user can browse the question and problems in order and answer the problems.
Input source/ Output destination	
Range/ Accuracy/ Margin of error	N/A
Unit	Screen
Time/ Velocity	When user takes test / Duration of the test
Relationship with other input/outputs	
Format and configuration of screen	<p>1. User is informed about the problem type by sound.</p> <p>2. The problem description is divided into lines and answer views in order.</p> <p>3. Each line view contains a single line of question.</p> <p>4. When line view is focused by VA, the description is spoken by VA's TTS service.</p> <p>5. When the answer view is focused by VA, the user can write the answer by keyboard and STT service.</p> <p>6. Answers by SST service are recorded and saved.</p> <p>7. Users can either go to previous or next question. The answers are sent to the server and recorded data is saved when moving to the next question.</p> 
Format and configuration of window	N/A

Data type	Text, sound
Instruction type	Sound
Exit message	N/A

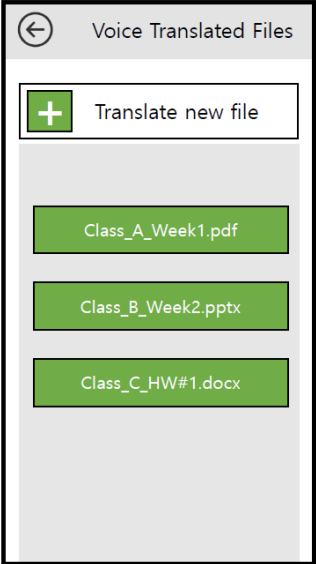
[Table 8] Test Interface 5 – Before test, After Test

Name	Test Interface 5 – Before test, After Test	
Purpose/Description	<p>The test is simply introduced.</p> <p>The user can browse the information about test</p>	
Input source/ Output destination	N/A	
Range/ Accuracy/ Margin of error	N/A	
Unit	Screen	
Time/ Velocity	N/A	
Relationship with other input/outputs	Answers are sent to the server.	
Format and configuration of screen	<ol style="list-style-type: none"> 1. User is informed about the test. 2. Users can exit the test by pressing the exit button. 3. Users can start to take tests. 	<ol style="list-style-type: none"> 1. User is informed that the test is over. 2. User can see his score and result. 3. Users can exit the test by the exit button or go to the main page of the course by going to the main button.

	 
Format and configuration of window	N/A
Data type	N/A
Instruction type	Text, Sound
Exit message	N/A

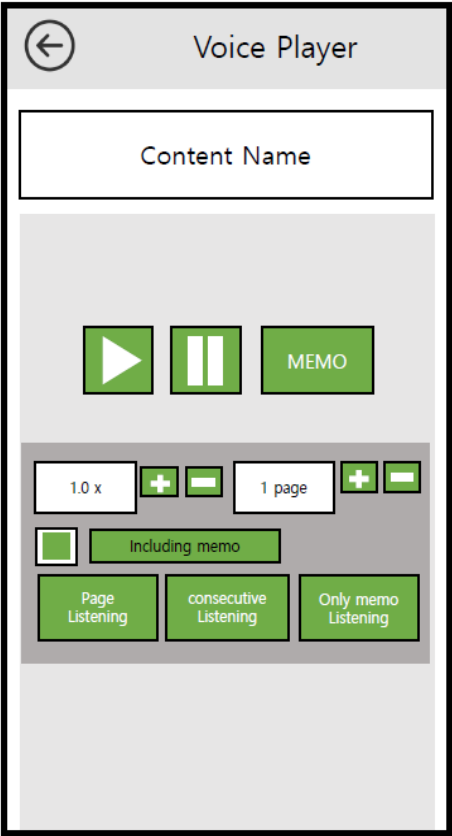
[Table 9] File Reader Interface1 – Voice-translated file list

Name	File Reader Interface1 – Voice-translated file list
Purpose/Description	A User can select voice-translated files (PDF, PPTX, DOCX, HWP) he/she want to listen to or translate a new file.
Input source / Output destination	User / Server (When a user select file to translate) Server / User (When users listen)
Range / Accuracy / Margin of error	N/A
Unit	A screen

Time / Velocity	N/A
Relationship with other input/outputs	N/A
Format and configuration of screen	<p>Alternative text must be properly entered.</p> <p>First line: Backward button, Translate new file button.</p> <p>When a user clicks the 'Translate new file' button, a file manager will open and the user can choose a file (PDF, PPTX, DOCX, HWP).</p> <p>Second line ~: A list of files that have already been translated is displayed.</p> 
Format and configuration of window	N/A
Data type	N/A
Instruction type	Instruction mapped to the button
Exit message	N/A

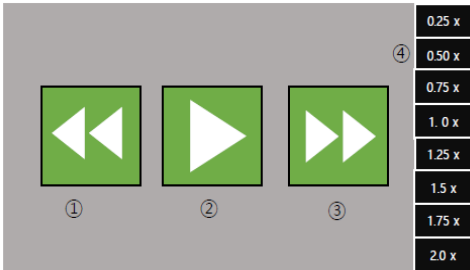
[Table 10] File Reader Interface2 – Voice-translated file player

Name	File Reader Interface2 – Voice-translated file player
Purpose/Description	<p>Users are able to listen to PDF, PPTX, DOCX, HWP file's contents by play & pause button.</p> <p>Users can make voice memos. If users want to make a memo, a voice file will pause. And users can record their voice.</p> <p>There are many options for listening. First, users can select a page to listen. And users can set whether to listen to only one page or consecutive pages. Second, users can adjust voice playback speed. Last, users can hear their voice memos only, or with file's contents.</p>

Input source / Output destination	Server / User (When users listen) User / Server (When users make voice memos)
Range / Accuracy / Margin of error	N/A
Unit	A screen
Time / Velocity	When making voice memos, time information should be accurately recorded.
Relationship with other input/outputs	N/A
Format and configuration of screen	<p>Alternative text must be properly entered.</p> <p>First line: Backward button, Content name</p> <p>Second line: Play, Pause, Memo.</p> <p>Selecting the memo button makes the voice file pause. And after recording is done, the user should select a memo again to save recording. To start the voice file again, the user should select the play button.</p> <p>Setting section's first line: Set play speed, Set first page, by +/- button.</p> <p>Setting section's second line: Checkbox to select whether to listen or not including notes.</p> <p>Setting section's third line: Page listening, Consecutive Listening, Only Memo listening. Users can choose 1 button of them.</p> 
Format and configuration of window	N/A
Data type	For play speed, its range is 0.25, 0.5, 0.75, 1, 1.25, 1.5, 1.75, 2.

	For start page, its range is 1 ~ (Last page of document)
Instruction type	Instruction mapped to the button
Exit message	N/A

[Table 11] Video Player

Name	Video Player
Purpose/Description	A User can play LearningX lecture video via this video player
Input source / Output destination	LearningX server / User
Range / Accuracy / Margin of error	N/A
Unit	A screen
Time / Velocity	When a user play lecture / length of video lecture
Relationship with other input/outputs	N/A
Format and configuration of screen	 <p>① : Rewind 10 seconds</p> <p>② : Play / Pause button</p> <p>③ : Fast forward 10 seconds</p> <p>④ : set play speed 0.25 x to 2.0 x</p>

Format and configuration of window	N/A
Data type	Video
Instruction type	Sound
Exit message	N/A

3.1.2. Hardware Interfaces

[Table 12] Applicable device for the system

Name	Applicable device for the system
Purpose/Description	To fully utilize function of the software, user device should have VA

3.1.3. Software Interfaces

[Table 13] Software interface of LearningX server

Name	LearningX server
Purpose/Description	Query input/output for managing multimedia/meta data
Input source/ Output destination	LearningX server/ User, User/LearningX server
Range/Accuracy/ Margin of error	Depends on the performance of the server hardware
Unit	Query

Time/ Velocity	Instant reaction
Relationship with other input/outputs	Related to all inputs/outputs from LearningX server
Format and configuration of screen	N/A
Format and configuration of window	N/A
Data type	Query, JSON
Instruction type	Query statement
Exit message	N/A

3.1.4. Communication Interfaces

Communication interface of client and LearningX server follows the api at document [1].

3.2. Functional Requirements

3.2.1. Use Case

[Table 14] Log in/out use case

Use case name	Log in/out
Actor	User, LearningX Server
Description	It is the process of logging in or out with an account registered with the LearningX server.

Normal Course	<Log in> <ol style="list-style-type: none"> 1. User enters ID and password. 2. If the ID and password is correct, the system allows the user to get into the system. <Log out> <ol style="list-style-type: none"> 1. There is no explicit logout function. It is automatically logged out when the application session expires
Precondition	The user should be connected to the network. Alternative text must be properly entered.
Post Condition	Grants the session access to other features of the app.
Assumptions	The user is visually impaired

[Table 15] Look up an assignment list use case

Use case name	Look up an assignment list
Actor	User, LearningX Server, LearningX app
Description	Users can check unfulfilled tests, lecture, lecture note, notice, homework and move directly to the corresponding content.
Normal Course	<ol style="list-style-type: none"> 1. User can check due date, class name of each unfinished assignments in the list 2. Users can directly access the contents from the list. For test, lecture, and lecture note, Voice Campus opens its own page. For other contents, Voice Campus opens LearningX app's corresponding page.
Precondition	Before showing the list to the user, the list should be updated by getting data from the LearningX server. The user should be logged in and connected to the network. Alternative text must be properly entered.
Post Condition	When the user finishes the task, the list should be updated.
Assumptions	The user is visually impaired

[Table 16] Do test use case

Use case name	Do test
Actor	User, LearningX Server
Description	A visually impaired user can take a test by this application with no helper.
Normal Course	<ol style="list-style-type: none"> 1. User enters the test section. 2. User is informed about the test description. 3. User starts the test and the problem type is informed. 4. Users hear problem description line by line using VA. 5. (1). Users answer multiple choice problems by sound and gesture. (2). Users answer short/essay problems by STT service. 6. Answers written by STT are recorded. 7. When the user goes to the next question, the answer is sent to the server and recorded data is saved. 8. When the user finishes the test, the recorded data is sent to the professor/TA by LearningX message system. 9. Professor/TA can check recorded data in the case of strange answers due to wrong STT translation.
Precondition	The user should be logged in and connected to the network. Alternative text must be properly entered.
Post Condition	All of the solved answers should be send to server
Assumptions	The user is visually impaired

[Table 17] Translate document file to voice file use case

Use case name	Translate document file to voice file
Actor	User, LearningX Server
Description	It is the process of translating a written document to the voice file. Users can select a file(PDF, PPTX, DOCX, HWP) or lecture note they want to hear and translate the file to voice.
Normal Course	<p><Document file from internal directory></p> <ol style="list-style-type: none"> 1. A user clicks the button 'File reader' to go to the voice-translated file select

	<p>page.</p> <ol style="list-style-type: none"> The user can select the file he/she wants to listen to by clicking 'Translate new file' and selecting file in the file explorer. Selected files will be translated to voice and will be added to voice-translated file list. <p><Document file from LearningX server></p> <ol style="list-style-type: none"> A user clicks lecture note contents in the assignment list. Download the lecture note from LearningX server. Then selected file will be translated to voice and will be added to voice-translated file list. The app screen changes to voice play screen.
Precondition	The user should be logged in and connected to the network. Alternative text must be properly entered.
Post Condition	Voice translated file(TTS file) should be saved to internal DB.
Assumptions	The user is visually impaired

[Table 18] Play voice-translated file use case

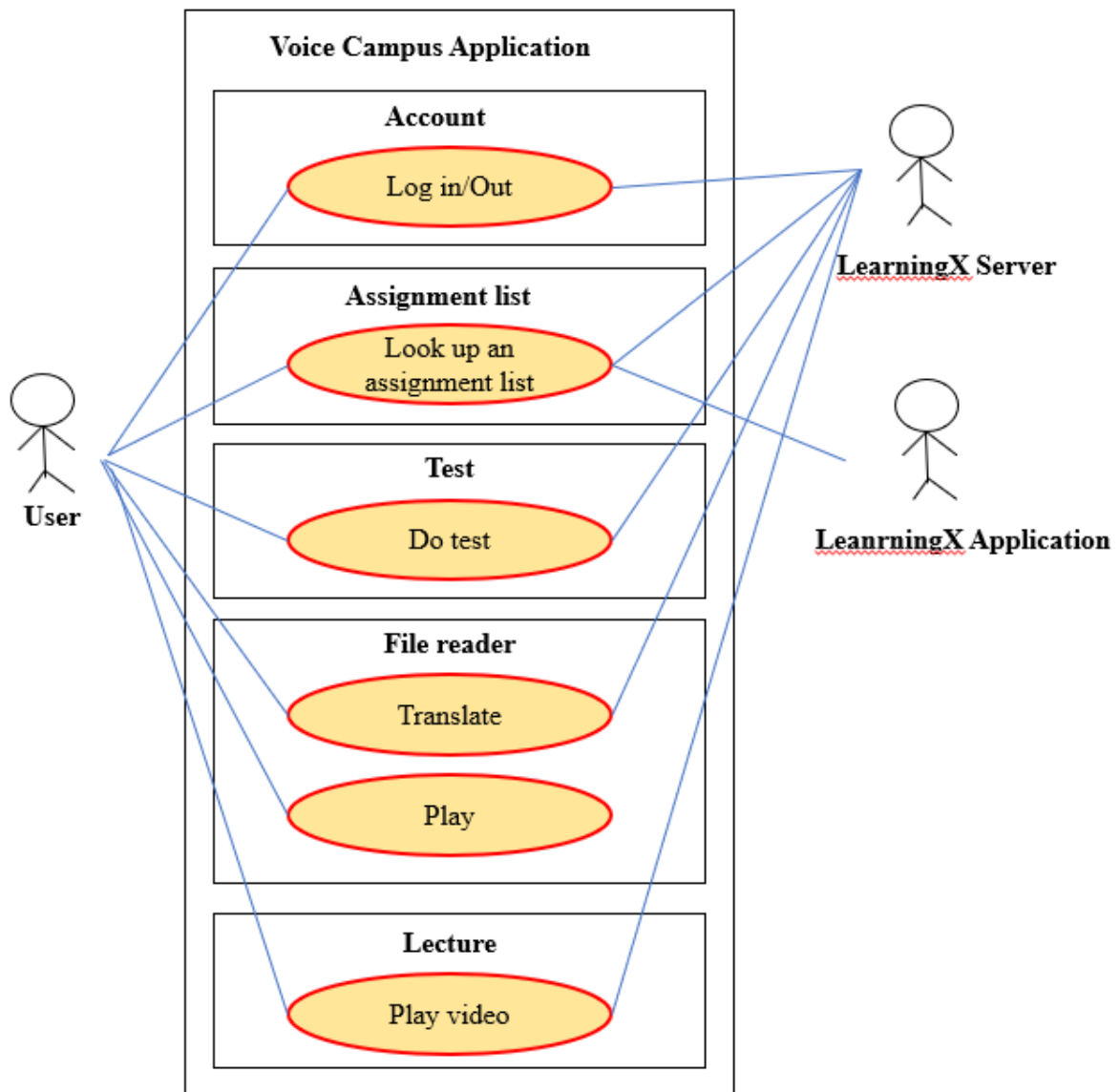
Use case name	Play voice-translated file
Actor	User
Description	Users can select files(PDF, PPTX, DOCX, HWP) they want to hear and listen to the voice-translated file. Users also can record his/her own voice for notes. Translated files are saved in the database.
Normal Course	<ol style="list-style-type: none"> A user clicks the button 'File reader' to go to the voice-translated file select page. The user can select the file he/she wants to listen to by clicking the file in the file list which has already been translated. When the user selects a translated file, the user can hear voice translated contents by play and pause button. The user can set play speed by clicking +/- button in the settings section from 0.25 ~ 2. The user can select the starting page by clicking +/- button in the settings section. The user can select to listen just a page, or consecutively.

	<ol style="list-style-type: none"> 7. The user can select whether to listen or not including notes. 8. The user can select to listen including memo, just contents, or just memo. 9. The user can make a voice memo by clicking the 'MEMO' button for recording his/her own voice within translated files. 10. If the voice file is running, it will stop after the user changes settings. And the progress users have heard so far will be initialized. And if the user selects the play button again, start playing according to the new setting.
Precondition	Alternative text must be properly entered.
Post Condition	Voice memo recorded by the user should be saved to internal DB.
Assumptions	The user is visually impaired

[Table 19] Play lecture video use case

Use case name	Play lecture video
Actor	User, LearningX server
Description	Users can play lecture videos of applied courses.
Normal Course	<ol style="list-style-type: none"> 1. A user clicks lecture contents in the assignment list. 2. Voice Campus receives the lecture video from LearningX server. A user can play and pause it. 3. The user can select play video from s/he left off last time or the beginning. 4. The user can check the lecture progress. 5. The user can change the play speed. 6. The user can move video back and forward by 10 seconds.
Precondition	<p>Lecture progress should be received by the server.</p> <p>The user should be logged in and connected to the network. Alternative text must be properly entered.</p>
Post Condition	Lecture progress should be sent to server
Assumptions	The user is visually impaired

3.2.2. Use Case Diagram



[Figure 1] Use case diagram

3.2.3. Data Dictionary

[Table 20] User data dictionary

Field	Key	Constraint	Description
user_id	PK	Not Null	user's learningX id
name		Not Null	real name of user
courses_id			id of courses user takes

[Table 21] Course data dictionary

Field	Key	Constraint	Description
course_id	PK	Not Null	id of course
course_name		Not Null	name of course
professor_id		Not Null	id of course professor

[Table 22] Test data dictionary

Field	Key	Constraint	Description
test_id	PK	Not Null	id of test
course_id		Not Null	id of course that test
title		Not Null	title of test
description			description of test
test_type		Not Null	type of test
start_at		Not Null	test start time
end_at		Not Null	test end time
problem_count		Not Null	problem count in test
points_possible		Not Null	maximum point of test

[Table 23] Problem data dictionary

Field	Key	Constraint	Description
problem_id	PK	Not Null	id of problem
test_id	PK	Not Null	id of test that problem belong to
position			position of problem in test
problem_title		Not Null	title of problem
problem_type		Not Null	4 types of problem
problem_text			text description of problem
points_possible		Not Null	maximum point of

			problem
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[Table 24] Assignment data dictionary

Field	Key	Constraint	Description
assignment_id	PK	Not Null	id of assignment
course_id		Not Null	id of course that assignment belong to
state		Not Null	3 types of states
due_at		Not Null	due time of assignment
link		Not Null	http/https link of assignment

[Table 25] Lecture data dictionary

Field	Key	Constraint	Description
lecture_id	PK	Not Null	id of lecture
course_id		Not Null	id of course that lecture belong to
title			title of lecture
state		Not Null	3 types of states
due_at			due time of lecture
link		Not Null	content link of lecture

[Table 26] Material data dictionary

Field	Key	Constraint	Description
material_id	PK	Not Null	id of material file
course_id		Not Null	id of course that material belong to
title			title of material

state		Not Null	3 types of states
link		Not Null	content link of material file

[Table 27] Announcement data dictionary

Field	Key	Constraint	Description
announcement_id	PK	Not Null	id of announcement
course_id		Not Null	id of course that announcement belong to
title			title of announcement
message		Not Null	message of announcement
link		Not Null	http/https link of announcement

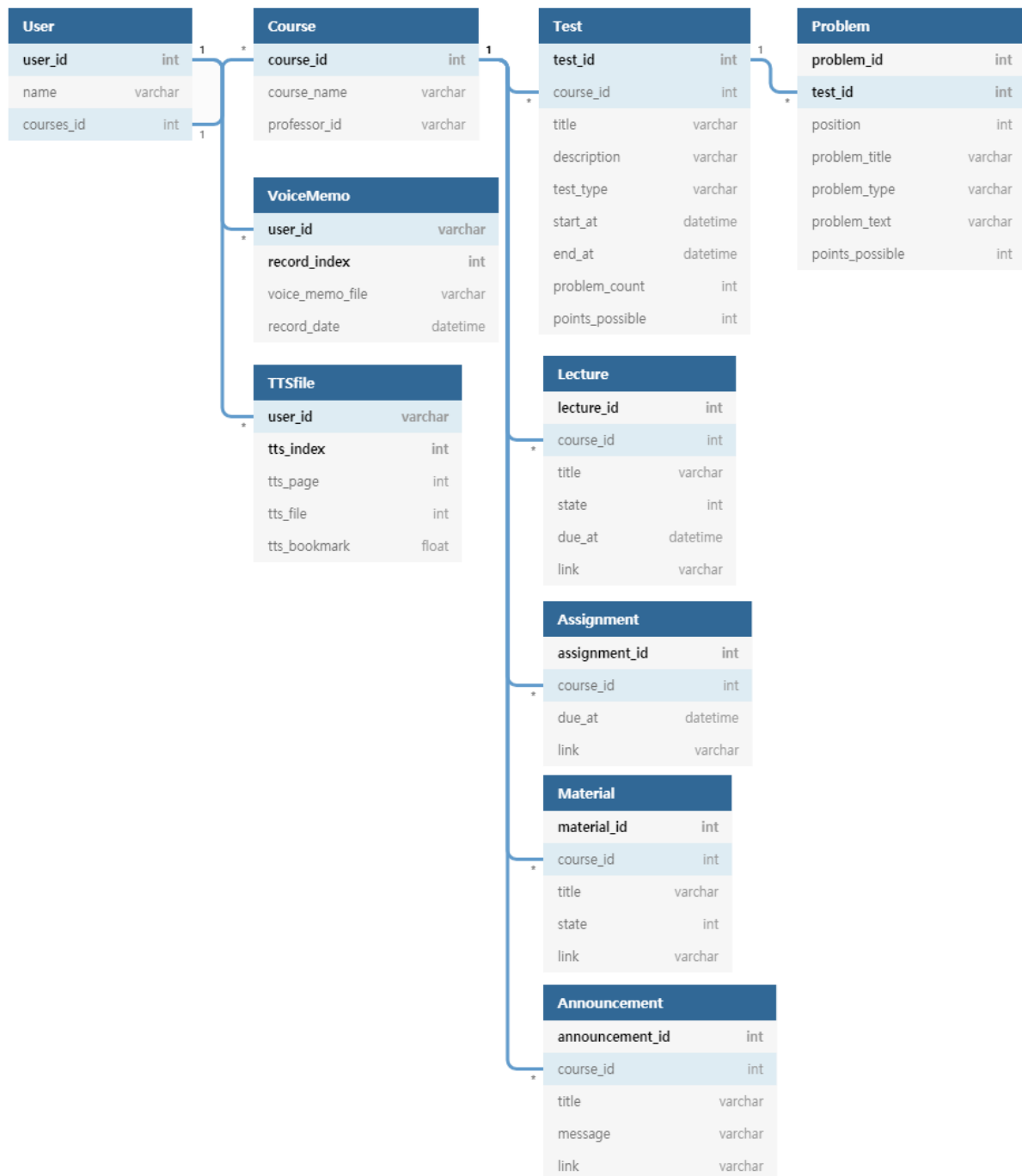
[Table 28] Voice memo data dictionary

Field	Key	Constraint	Description
user_id	PK	Not Null	user's learningX id
record_index	PK	Not Null	Specific user's record index
voice_memo_file		Not Null	voice memo file
record_date			date of record

[Table 29] TTS file data dictionary

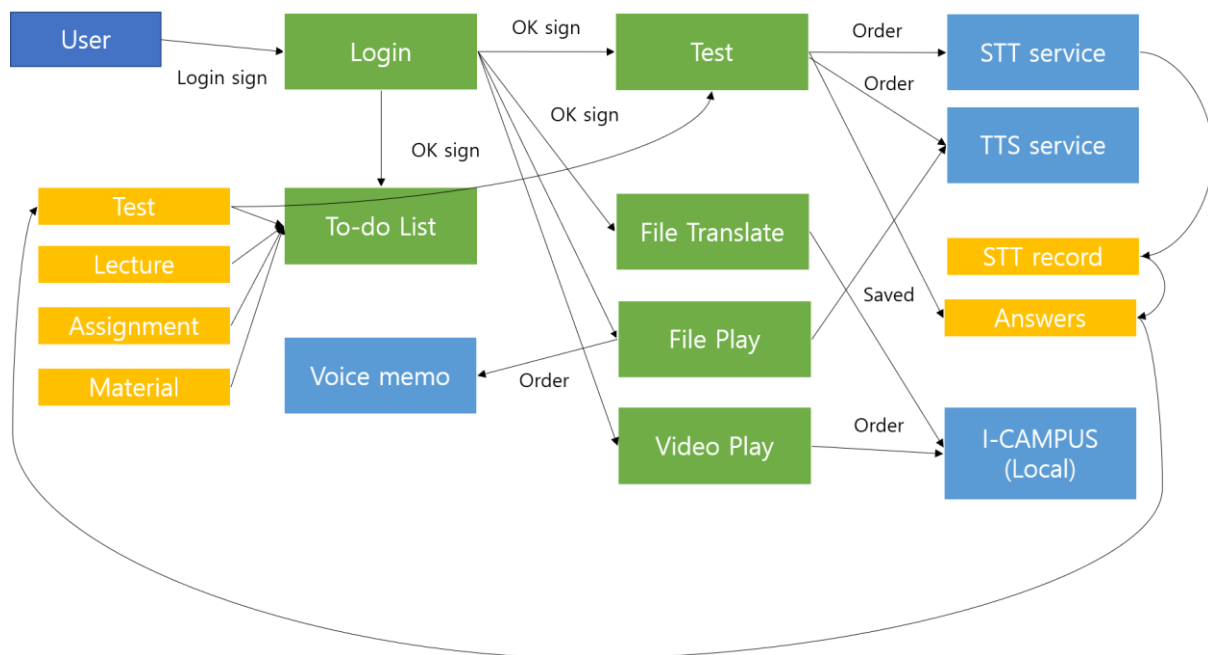
Field	Key	Constraint	Description
user_id	PK	Not Null	user's learningX id

tts_index	PK	Not Null	specific user's translation index
tts_page		Not Null	page of original file
tts_file		Not Null	voice-translated file
tts_bookmark			last playpoint of translated file



[Figure 2] Entity Relationship Diagram

3.2.4. Data Flow Diagram



[Figure 3] Data Flow Diagram

3.3. Performance Requirements

This section describes the performance requirements of Voice Campus. This section is divided into two parts: Static numerical requirements and dynamic numerical requirements. Static numerical requirements mainly cover items that are not related to time. On the other hand, dynamic numerical requirements cover items that are related to time.

3.3.1. Static numerical requirements

- 1) The number of terminals to be supported is only one, LearningX server.
- 2) Excluding Database, app size has to be less than 1GB.

3.3.2. Dynamic numerical requirements

- 1) The time taken to display the assignment list shall not exceed 1 second per item.
- 2) The wait time must be no more than 5 seconds when transferring to another activity.
- 3) The time to convert a document file to a voice file should be less than 1 minute per page.
- 4) If you press a memo button while listening to the voice file, the voice file should be paused within 1 second.
- 5) When listening to a memo file and a voice file together, the interval between the two files should be less than 5 seconds.
- 6) The video resolution of the lecture always remains above 480p.

3.4. Logical Database Requirements

It is not necessary to develop an external database for the development of the system. However, it needs to get the necessary information from the LearningX server's database.

It stores internal databases on mobile devices. Because the database is not large and complicated, the system uses SQLite.

For more information, refer to the 3.2.3. Data Dictionary.

3.5. Design Constraints

The most important principle is that the system has to be visual impairment friendly. This requires compatibility with VA, which reads the screen. In order to do so, it is necessary to make the component layout neat. And make sure that there are as little components as possible in one screen. And putting in the alternate text properly is also an important part. Using strong color contrast is recommended, but does not use red-green contrast for the case that the system is used by a person who is an incomplete color blindness. And making screen components as large as possible is also recommended.

Only design resources that are not against copyright should be used. The system should also be made to support the resolution of various mobile devices.

3.6. Standards compliance

For database naming, follow these guidelines: avoid quotes, write entirely in lower case, do not use data types and reserved words as name, use underscore for separate words, don't use arbitrary abbreviations and use complete word and common abbreviations.

When making an Android app, follow guidelines from Android. On the other hand, when making an iOS app, follow guidelines from Swift. Readers can find the link of the above guidelines in section 1.4.

3.7. Non-functional Requirements

This section shows several non-functional requirements of the system because software system characteristics are well understood through non-functional requirements.

Non-functional requirements can be classified as Product Requirements, Organization Requirements, External Requirements.

3.7.1. Product Requirements

Product Requirements are description of the requirements that must be satisfied when our software is operating. Our software system should satisfy following requirements.

3.7.1.1. Usability Requirements

Because this system is for visually impaired students, usability is paramount non-functional requirement. Since the function of the app needs to be available without looking at the screen of the smartphone, auditory assistance is the most important thing. The user should be able to use the functionality of the application with VA and minimal touch, and the interface of the application should be optimized to meet this requirement.

3.7.1.2. Performance Requirements

The performance of a system depends on how quickly the system can respond to user requests. For requests such as translating the voice of a textbook file and making the user's voice into text (STT), the system must be able to produce and provide the result to the user in up to 10 seconds.

3.7.1.3. Reliability Requirements

Reliability is important for features of this system that require error-free operation within a time limit, such as test assistance. The system must provide accurate output for the input of the user.

3.7.2. Organizational Requirements

These requirements are broad system requirements derived from policies and procedures in the customer's and developer's organizations.

3.7.2.1. development Requirements

Since the system is developed using open source software, it must be developed to meet the requirements and specifications of each component.

3.7.2.2. Operational Requirement

The system works in conjunction with the LearningX server, so the interworking must be stable for smooth operation. This system works as an application in smartphones and should work at any-time a user wants to use. The system also should provide a visually impaired user-friendly interface in overall application.

3.7.3. External Requirements

This is a description of the requirement for the external environment of the system.

3.7.3.1. Safety / Security Requirement

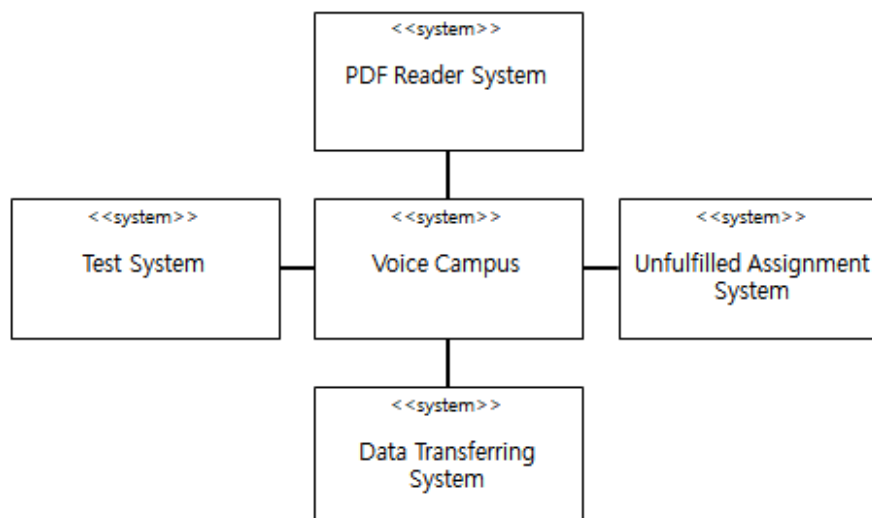
The system needs to be secured against unauthorized access to users' personal information. The system should also ensure that the information and data of the users are well preserved without being lost.

3.7.3.2. Regulatory Requirement

The software shall not infringe on opensource licenses when using opensource software. Also, the system should be developed in accordance with a national Privacy standard.

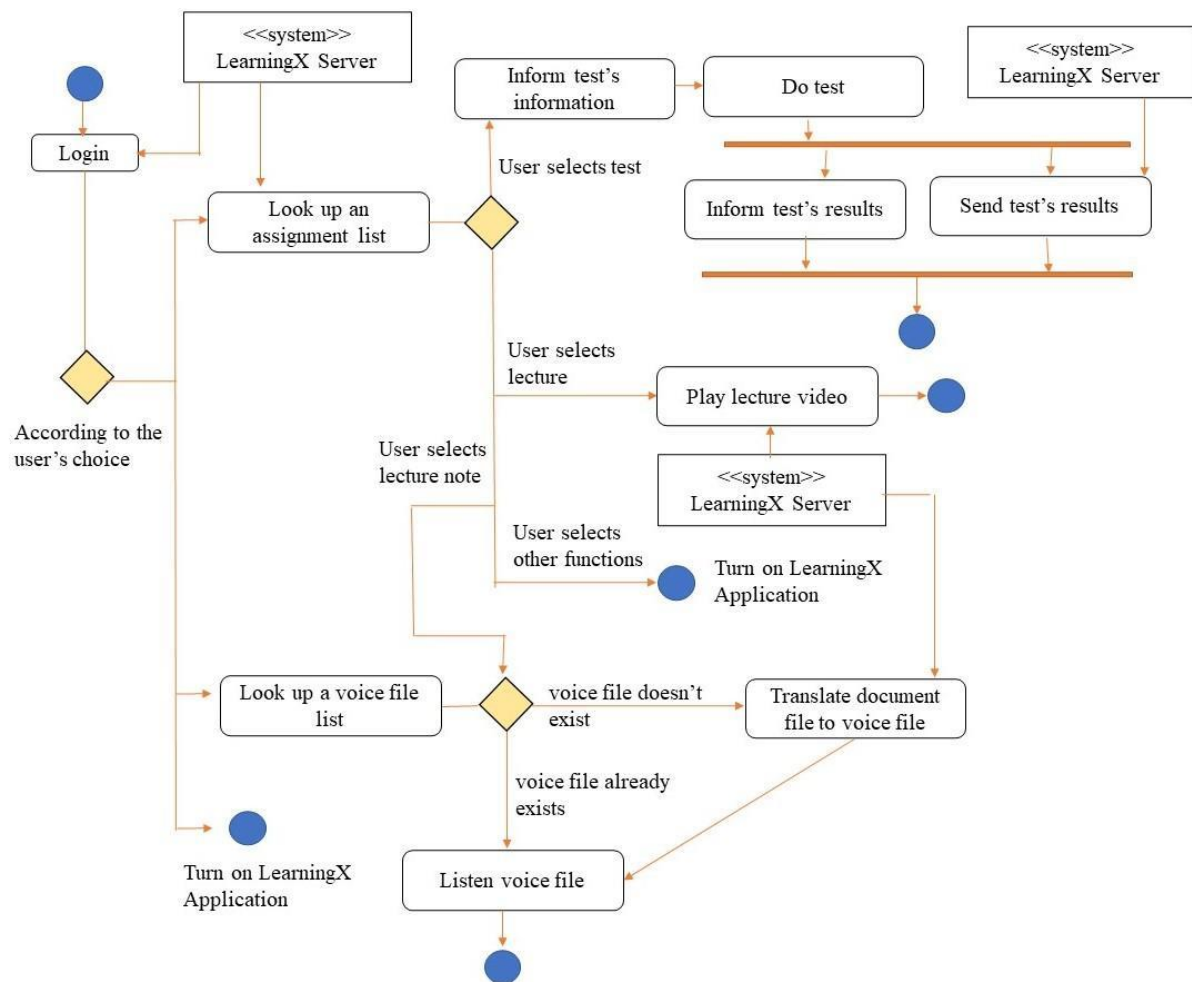
3.8. Organizing the Specific Requirements

3.8.1. Context Model



[Figure 4] Context model

3.8.2. Process Model



[Figure 5] Process model

3.8.3. Interaction Model

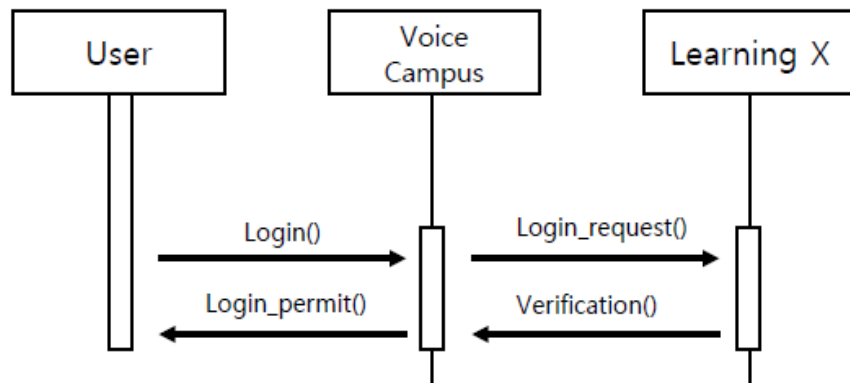
See 3.2.2. Use Case Diagram.

3.8.4. Behavior Model

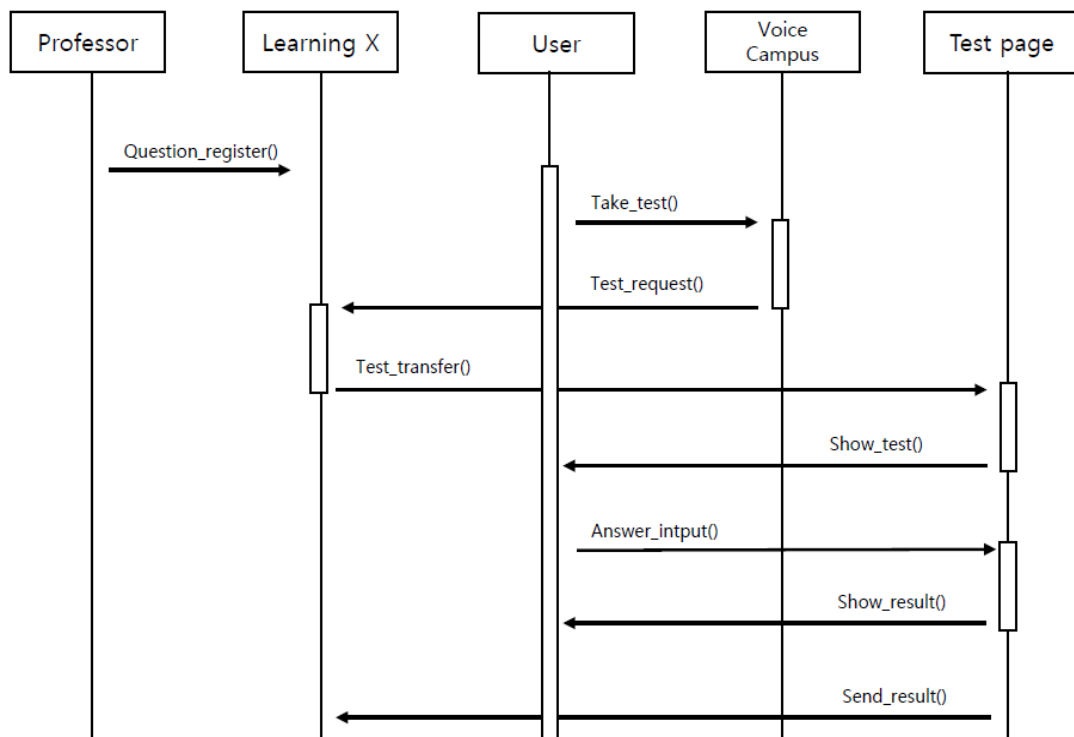
3.8.4.1. Data Flow Diagram

See 3.2.4. Data Flow Diagram.

3.8.4.2. Sequence Diagram



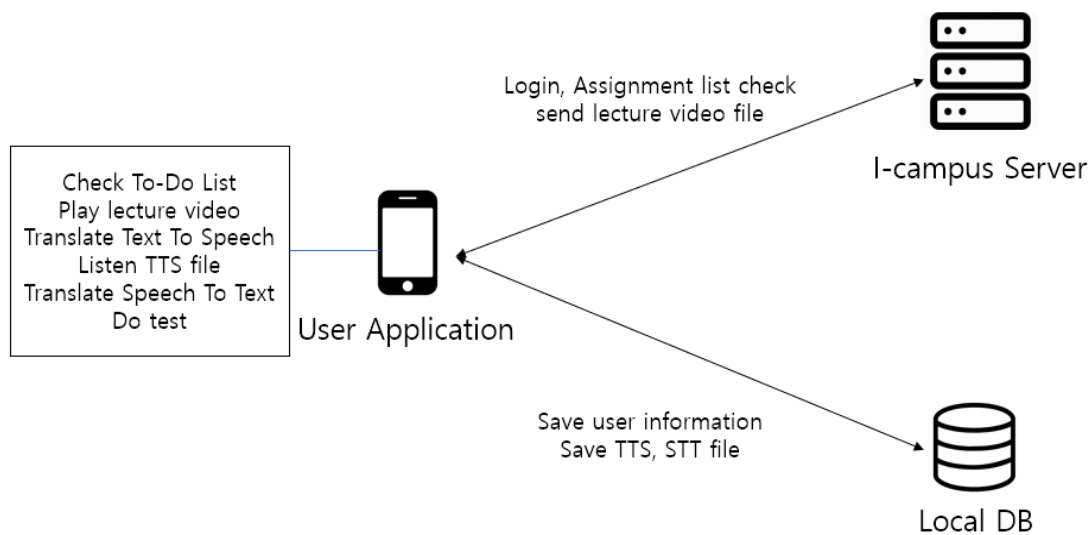
[Figure 6] Login process sequence diagram



[Figure] 7 Test taking process sequence diagram

3.9. System Architecture

This section presents an abstract overview diagram of system architecture, showing the distribution of functions across system modules.



[Figure 8] System architecture

3.10. System Evolution

We have put some fundamental assumptions on the system when specifying the requirements. Our assumptions, however, might have been wrong or there might be change in requirements due to change in the operating environment or technological evolvement. In this section, those assumptions and possible changes will be introduced.

3.10.1. Limitation and Assumption

The Voice Campus assumes that many professors using the system will actively participate. Professors should put additional descriptions for the picture and diagram in the material. In addition, when STT service makes mistakes in the test system, it is the professor's job to check the audio file and match it with the answer sheet. The system, however, assumes that professors are all passionate and fully supporting adding descriptions to pictures and reviewing student's answers.

3.10.2. Evolutions of Hardware and Change of User Requirements

In the process of performing the system, professors, however, might forget to put descriptions on the picture or make mistakes when checking student's answers. In addition, too much burden on professors might lead to other mistakes on the performance. If these human errors occur more than expected, the system's overall dependency will fall. Therefore, in that case, additional functions should be added to complement the system. First, we might implement image recognition AI trained

with machine learning which automatically adds explanations to diagrams and pictures in the material. The second is to create a system that allows students to check and modify answers generated by STT line by line, reducing the number of times that professors have to check voice files significantly.

4. Supporting Information

4.1. Software Requirement Specification

This software requirement specification is based on IEEE Guide to Software Requirements Specifications (Std 830-1993).

4.2. Document History

[Table 30] Document history

Date	Version	Description	Writer
2021/04/12	1.0	Addition of 1.2	Kang Hyunmuk
2021/04/12	1.1	Addition of 1.5	Kim Jihye
2021/04/12	1.2	Addition of 3.1	Park Jiye
2021/04/12	1.3	Addition of 1.1	Shin Wonchul
2021/04/12	1.4	Addition of 2.4, 2.5	Oh Seungjun
2021/04/15	1.5	Addition of 3.1	Kang Hyunmuk
2021/04/15	1.6	Addition of 3.1	Kim Jihye
2021/04/16	1.7	Addition of 2.2, 2.3	Park Jiye
2021/04/16	1.8	Addition of 3.2, 3.3	Shin Wonchul
2021/04/16	1.9	Addition of 3.3	Oh Seungjun
2021/04/18	2.0	Addition of 3.7	Kang Hyunmuk
2021/04/18	2.1	Addition of 3.8.2	Kim Jihye
2021/04/18	2.2	Addition of 2.1	Park Jiye
2021/04/18	2.3	Addition of UIs	Shin Wonchul
2021/04/18	2.4	Addition of 3.1.3, 3.1.4	Oh Seungjun
2021/04/23	2.5	Addition of 3.9	Kang Hyunmuk

2021/04/23	2.6	Addition of 3.2.2	Kim Jihye
2021/04/23	2.7	Addition of 3.2.4	Park Jiye
2021/04/23	2.8	Addition 3.10, 3.8	Shin Wonchul
2021/04/23	2.9	Addition of 3.2.3	Oh Seungjun