Bilkent University

Department of Computer Engineering

CS491 Course Project

Vox

Project Analysis Report

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1 Introduction

Sign Language is a nonverbal language that people with hearing and speaking disabilities use to communicate with the rest of the world. It is built upon the visual use of hands, eyes, face and mouth. It is a complete, natural way of communication that shares similar linguistic properties as spoken languages. Sign language is adapted by deaf communities as a useful means of communication [1]. It is an integral part of their lives. According to an article on HRW there are more than 70 million people around the world that depend on sign language to communicate [2]. With the help of this technique these people are able to learn, work and be included in their local communities. It helps to ensure disabled people live a life on an equal basis with non-disabled people.

Even though deaf people use sign language to communicate with other people, the majority of the population don't know how to use sign language and this creates a communication barrier between the deaf community and the rest of the population. According to Human Rights Watch's research on deaf people's rights, lack of awareness on sign language causes deaf people to struggle while accessing public services all around the world. Deaf communities are excluded from essential parts of life such as: health, education, justice because of face to face communication problems [3]. Only a small fraction of these services have reasonable adjustments for disabled people to benefit from them. A recent study led by the British Deaf Association states some of the key areas affecting the deaf community with their relationship with the public. There is a lack of awareness in booking, insufficient interpreters, and a lack of understanding about deaf people and their levels of written English [4]. As a team we are determined to meet the needs of the deaf community.

One of the best ways to reduce the communication barrier that the deaf community is facing is by teaching people how to communicate with sign language. There are courses that people can attend and learn sign language but they are not always a feasible solution. In modern life not everyone has enough spare time and money to spend on such courses. Instead, people can use mobile applications to learn new languages. These kinds of applications are very common for spoken languages like English, Turkish etc. but it is not the case with sign language. Our project idea started out when we realized the lack of efficient sign language teaching applications.

Supervising students and performance measurement is very important in teaching sign language to verbal language users. It is because sign language depends on body movements and learning these movements precisely is crucial. We would like to address this problem by providing a service where we will track the hand movements and gestures of the user and then process them to check how well

they have learned the sign language, measure their performance, and provide appropriate feedback based on how well they use the correct signs and gestures.

In our project analysis report we are going to briefly explain the overview of the project, go over the functional, non-functional and pseudo requirements. Moreover, system models will be explained. Lastly, other analysis elements will be introduced.

2 Proposed System

2.1 Overview

Vox is a service which aims to improve the communication between the deaf community and the rest of the world by teaching how to use sign language to its users. Our name represents what we provide for our users and it is Latin for voice. Our application will become the voice of the deaf and the mute communities. The main goal of this application is to become an American Sign Language (ASL) recognition engine and teach ASL to its users by asking them for the correct gestures which it then captures and translates to sign language, determining whether the user has used the correct gesture or not, using nothing but a simple camera. With this technology we can provide an effective learning tool for any individual that wishes to learn ASL.

This application will feature a handful of different activities that will teach ASL to its users in fun and engaging ways, and they will all be accessible via a simple and clean user interface that can be easily navigated. The application will track the hand movements of its users during these activities to measure their performance, providing appropriate feedback based on how well they use the correct signs and gestures to complete the activities. The current mobile applications that teach sign language do not provide a tracking for hand movements for a smooth and well-supervised learning experience. There are prototypes which can currently understand up to 100-200 sign language sentences [5], but it is not enough yet to be used as a supervised sign language learning tool.

We plan to use Google's MediaPipe for developing customized machine learning models for hand tracking, human pose detection and face gesture tracking. In addition to that we want to apply advanced neural network models to further improve the efficiency of our service such as Convolutional Neural Networks (CNN). As for the datasets we have found several and ready-to-use open-source datasets but we plan to further improve our system by training it with user data if the user gives permission. As we get more users, our model will improve on the fly. We will also apply computer vision techniques, image processing and deep learning.

Our mission is to radically improve the life standards of deaf and mute people via helping them be understood by non-disabled people. We want to become their voice.

2.2 Functional Requirements

2.2.1 Gesture Recognition

- The system should be able to recognize sign language with the device's camera using recognition in real time.
- The system should be able to recognize hand gestures from various different skin colors.
- The system should be able to recognize gestures under different lighting conditions.

2.2.2 Sign Language Translation

- The system should be able to translate the recognized sign language gestures to English text.
- The system should be able to combine consecutive gestures to form larger phrases.
- The system should be able to determine when a word starts and when a word ends.
- The system should be able to only translate American Sign Language to the corresponding English text.

2.2.3 Activities and Leaderboards

- The system should provide different activities for the user for them to learn ASL in different ways, such as spelling individual words or constructing full sentences.
- The system should reward the player with an appropriate number of points based on their performance on an activity.
- The system should keep track of the streak of consecutive days that a user uses the application.
- The system should keep track of the total number of sign language gestures learned
- The system should provide achievements for the user that rewards them with a generous number of points upon completion.
- The system should place the users in various leagues, each with their own leaderboards, based on their points.

2.2.4 Social Features

- The system should allow the users to send friend requests to other users.
- The system should allow the users to receive, and deny or accept incoming friend requests from other users.
- The system should allow the users to track their friends' stats such as their number of points, their leagues and their total number of sign language gestures learned.

2.3 Non-functional Requirements

2.3.1 User Interface

- Everything in the user interface must be easily readable. Grammar errors should be avoided and contrasting colors should be used for texts or icons and their backgrounds.
- There shouldn't be any non-functional elements on the user interface that may falsely give the impression that they are functional pieces, i.e There shouldn't be any solely decorative elements that look like buttons or text fields.

2.3.2 Performance Characteristics

- The application should handle the translation process at the server side in order to lower the battery consumption.
- The application should be able to translate the provided footage in real-time.
- The application should be able to send the real-time footage to the server in less than 3 seconds.
- The server should be able to respond in less than 3 seconds.

2.3.3 Error Handling and Extreme Conditions

- The system should display appropriate error messages whenever the user doesn't follow what they are supposed to do. The user must be properly informed about what they have done wrong and what the correct course of action would be.
- The system should be able to handle any error that would be the result of the user's own actions. Any functionality or design element of the

application must not fail to work or load properly when a user doesn't follow the application's intended design.
- If any exceptions or crashes occur due to the technical errors originating from the flaws of the work done by the developers, such as logic errors in the source code, it must be apparent for the user that the error is due to a bug that must be fixed by the developers and not due to an error of their own.

2.3.4 Quality
- The translation done by the system must be at least 90% accurate on average.
- The system should be able to recognize the appropriate gestures as ASL with at least a 80% success rate on average.

2.3.5 Security
- The system should ask for permission by the user to use the camera or any similar recording unit on their device.
- The system must not share any information gathered by the recording with the user other than what is relevant, which is the translation and the assessment of the sign language being used in front of the recording unit.

2.3.6 Supportability
- The application should be available on the Android operating system.
- The application should be runnable on almost every device that supports these operating systems regardless of its specific hardware components except for the camera, which should be mandatory. Performance of the program could increase or decrease with respect to these hardware specifications, but they should not restrict the user from being able to use the application on their phone.

2.3.7 Usability
- The users should be able to start the real-time translation with at most two clicks.
- The users should be able to access the tutorial video with a single click.
- The users should be able to send feedback with at most two clicks.

2.3.8 Accessibility

- The users should be able to download the program for free.
- The users should be able to download the program from either https://s-guydescend.github.io/vox/ or Google Play Store.

2.4 Pseudo Requirements

- Python libraries will be used for developing machine learning, neural network, and computer vision algorithms
- Google's MediaPipe will be used for developing customized machine learning models for hand tracking, human pose detection and face gesture tracking
- Amazon Web Services will be used for cloud services
- Amazon SDK Boto3 will be used while interacting python code with AWS services
- MySQL and SQL will be used for database and database maintenance.
- Ionic Framework will be used for cross platform mobile application development
- GitHub will be used for version control during development.
- Atlassian Jira will be used for team load management

2.5 System Models

2.5.1 Scenarios

2.5.1.1 Launch Scenario

Participating Actor: User
Entry Conditions: User clicks on the app icon and connected to the internet
Exit Conditions: User logins, User goes to create new account page
Flow of Events:
1. User clicks application icon on mobile
2. Application opens and showcases a launching screen while connecting to database and server
3. User is given two options: Login or create new account

2.5.1.2 Lesson Scenario

Participating Actor: User
Entry Conditions: User is logged in and connected to the internet
Exit Conditions: User clicks exit button
Flow of Events:
1. User clicks "Lesson" button in the main menu
2. Application shows the list of the lessons

3. User selects a lesson from the list
4. Application displays a question and opens the camera of the device
5. User records his/her gestures and clicks end button
6. Application displays whether the answer provided is right or wrong
7. Application prompts the user if s/he want to continue
8. If the user selects exit, the application quits the lesson menu. If the user selects continue, the application returns to event no 6.

2.5.1.3 Translate Scenario

Participating Actor: User
Entry Conditions: Application is open and connected to the internet
Exit Conditions: Translation result is retrieved from server
Flow of Events:
1. User clicks "Translate" button
2. Application opens the camera of the device
3. User records the gestures s/he wants to translate and clicks end
4. Application displays the result of the translation

2.5.1.4 Profile Scenario

Participating Actor: User
Entry Conditions: User clicks profile option in navigation bar
Exit Conditions: User clicks to a new option from navigation bar
Flow of Events:
1. User clicks "Profile" button
2. Application displays the information about the account such as : User Name, Completion, Longest Streak, League, Number of words learned.

2.5.1.5 Quiz Scenario

Participating Actor: User
Entry Conditions: User selects a quiz to solve
Exit Conditions: All questions in the quiz are solved
Flow of Events:
1. User clicks "Quiz" button
2. The application displays a question and opens the camera of the device
3. User records his/her gestures and clicks submit
4. The application displays the score of the user.

2.5.1.6 Login Scenario

Participating Actor: User
Entry Conditions: User clicks on the login button
Exit Conditions: User information is verified
Flow of Events:
1. User enters appropriate username
2. User enters appropriate password
3. User information is verified from database
4. User information is authenticated
5. User skips to home page of his/her profile

2.5.1.7 Create New Account Scenario

Participating Actor: User
Entry Conditions: User clicks on the create new account button
Exit Conditions: New user is added to database successfully
Flow of Events:
1. User enters name information
2. User enters username information
3. User enters password information
4. User verifies password
5. User enters email information
6. User verifies email
7. User skips to home page of his/her profile
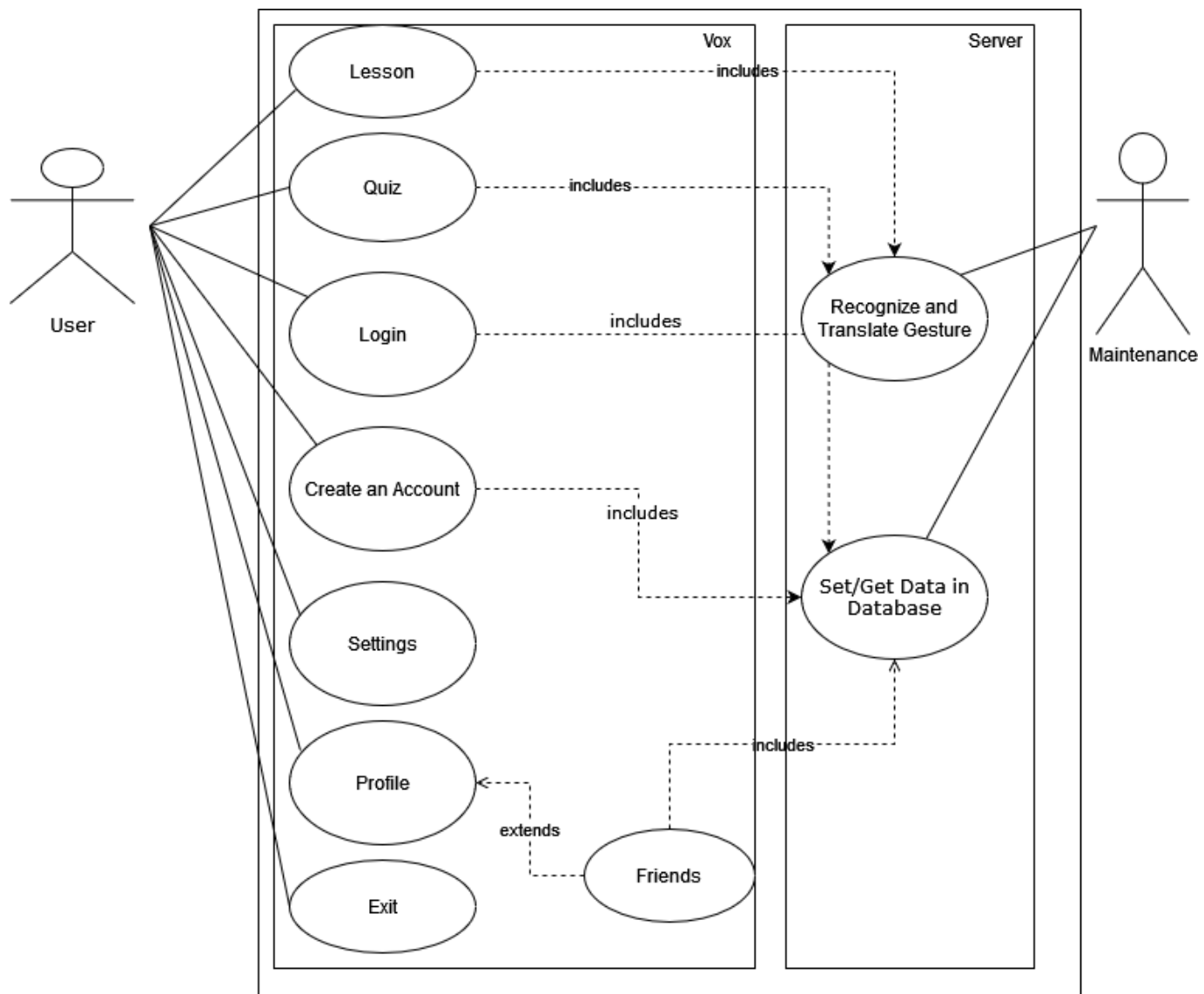
2.5.2 Use Case Model

Figure 1: Use Case Diagram
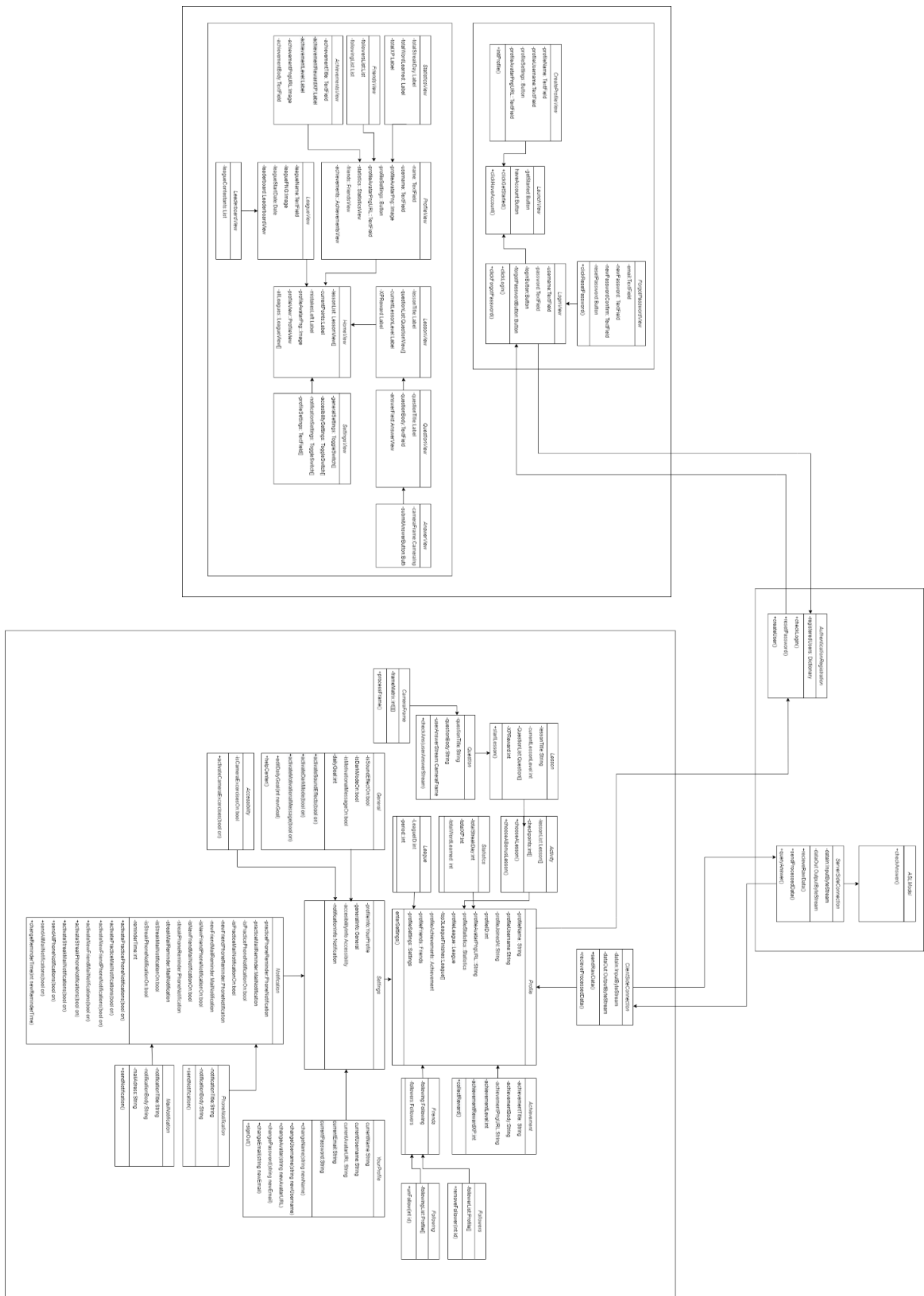
2.5.3 Object and Class Model
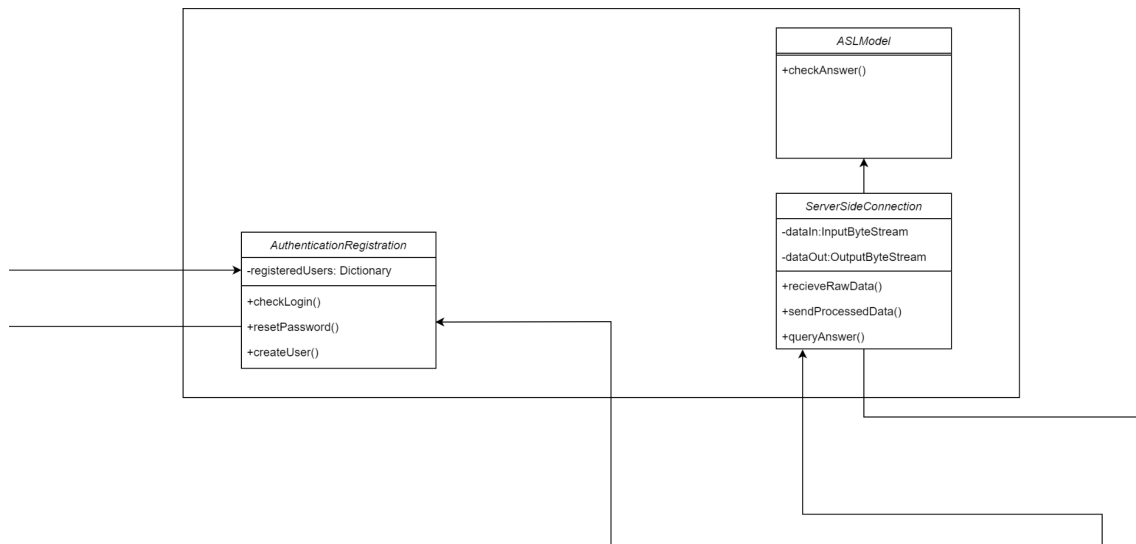

Figure 2: Class Diagram

Figure 2.1: Top Part of Class Diagram (Server)

ASLModel
+checkAnswer()

ServerSideConnection
-dataIn:InputByteStream
-dataOut:OutputByteStream
+recieveRawData()
+sendProcessedData()
+queryAnswer()

AuthenticationRegistration
-registeredUsers: Dictionary
+checkLogin()
+resetPassword()
+createUser()

Figure 2.1: Top Part of Class Diagram (Server)

Figure 2.2: Left Part of Class Diagram (UI)

ForgotPasswordView
-email:TextField
-newPassword: TextField
-newPasswordConfirm: TextField
-resetPassword:Button
+clickResetPassword()

CreateProfileView
-profileName: TextField
-profileUsername:TextField
-profileSettings::Button
-profileAvatarPngURL::TextField
+initProfile()

LaunchView
-getStarted:Button
haveAccount:Button
+clickGetStarted()
+clickHaveAccount()

LoginView
-username:TextField
-password:TextField
-loginButton:Button
-forgotPasswordButton:Button
+clickLogin()
+clickForgotPassword()

StatisticsView
-totalStreakDay:Label
-totalWordLearned: Label
-totalXP:Label

FriendsView
-followersList:List
-followingList:List

AchievementsView
-achievementTitle: TextField
-achievementRewardXP:Label
-achievementLevel:Label
-achievementPngURL:Image
-achievementBody:TextField

ProfileView
-name: TextField
-username: TextField
-profileAvatarPng::Image
-profileSettings::Button
-profileAvatarPngURL::TextField
-statistics::StatisticsView
-friends::FriendsView
-achievements::AchievementsView

LeagueView
-leagueName:TextField
-leaguePNG:Image
-leagueStartDate:Date
-leaderboard:LeaderboardView

LeaderboardView
-leagueContestants:List

LessonView
-lessonTitle:Label
-questionList:QuestionView[]
-currentLessonLevel:Label
-XPReward:Label

HomeView
-lessonList: LessonView[]
-currentPoints:Label
-mistakesLeft:Label
-profileAvatarPng::Image
-profileView::ProfileView
-allLeagues::LeagueView[]

QuestionView
-questionTitle:Label
-questionBody:TextField
-answerField:AnswerView

AnswerView
-cameraFrame:CameraInp
-submitAnswerButton:Butt

SettingsView
-generalSettings: ToggleSwitch[]
-accesibilitySettings: ToggleSwitch[]
-notificationSettings: ToggleSwitch[]
-profileSettings: TextField[]

Figure 2.2: Left Part of Class Diagram (UI)

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ClientSideConnection
- -dataIn:InputByteStream
- -dataOut:OutputByteStream
- +sendRawData()
- +recieveProcessedData()

Lesson
- -lessonTitle:String
- -currentLessonLevel:int
- -QuestionList:Question[]
- -XPReward:int
- +startLesson()

Activity
- -lessonList:Lesson[]
- -checkpoints:int[]
- +chooseALesson()
- +chooseABonusLesson()

Profile
- -profileName: String
- -profileUsername:String
- -profileJoinedAt:String
- -profileID:int
- -profileAvatarPngURL::String
- -profileStatistics::Statistics
- -profileLeague::League
- -top3LeagueFinishes:League[]
- -profileAchievements::Achievement
- -profileFriends::Friends
- -profileSettings::Settings
- enterSettings()

Achievement
- -achievementTitle: String
- -achievementBody:String
- -achievementPngURL:String
- -achievementLevel:int
- -achievementRewardXP:int
- +collectReward()

Followers
- -followerList:Profile[]
- +removeFollower(int id)

Statistics
- -totalStreakDay:int
- -totalXP:int
- -totalWordLearned: int

Question
- -questionTitle:String
- -questionBody:String
- -userAnswerStream:CameraFrame
- +checkAns(userAnswerStream)

League
- -LeagueID:int
- -period::int

Friends
- -following:Following
- -followers:Followers

Following
- -followingList:Profile[]
- +unFollow(int id)

CameraFrame
- -frameMatrix:int[][]
- +processFrame()

General
- -isSoundEffectOn:bool
- -isDarkModeOn:bool
- -isMotivationalMessageOn:bool
- -dailyGoal:int
- +activateSoundEffects(bool on)
- +activateDarkMode(bool on)
- +activateMotivationalMessage(bool on)
- +editDailyGoal(int newGoal)
- +helpCenter()

Settings
- -profileInfo:YourProfile
- -generalInfo:General
- -accessibilityInfo:Accessibility
- -notificationInfo:Notification

YourProfile
- currentName:String
- currentUsername:String
- currentAvatarURL:String
- currentEmail:String
- currentPassword:String
- +changeName(string newName)
- +changeUsername(string newUsername)
- +changeAvatar(string newAvatarURL)
- +changePassword(string newEmail)
- +changeEmail(string newEmail)
- +signOut()

Accessibility
- -isCameraExcercisesOn:bool
- +activateCameraExcercises(bool on)

Notification
- -practicePhoneReminder:PhoneNotification
- -practiceMailReminder:MailNotification
- -isPracticePhoneNotificationOn:bool
- -isPracticeMailNotificationOn:bool
- -newFriendPhoneReminder:PhoneNotification
- -newFriendMailReminder:MailNotification
- -isNewFriendPhoneNotificationOn:bool
- -isNewFriendMailNotificationOn:bool
- -streakPhoneReminder:PhoneNotification
- -streakMailReminder:MailNotification
- -isStreakMailNotificationOn:bool
- -isStreakPhoneNotificationOn:bool
- -reminderTime:int
- +activatePracticePhoneNotifications(bool on)
- +activatePracticeMailNotifications(bool on)
- +activateNewFriendPhoneNotifications(bool on)
- +activateNewFriendMailNotifications(bool on)
- +activateStreakPhoneNotifications(bool on)
- +activateStreakMailNotifications(bool on)
- +sendAllPhoneNotifications(bool on)
- +sendAllMailNotifications(bool on)
- +changeReminderTime(int newReminderTime)

PhoneNotification
- -notificationTitle:String
- -notificationBody:String
- +sendNotification()

MailNotification
- -notificationTitle:String
- -notificationBody:String
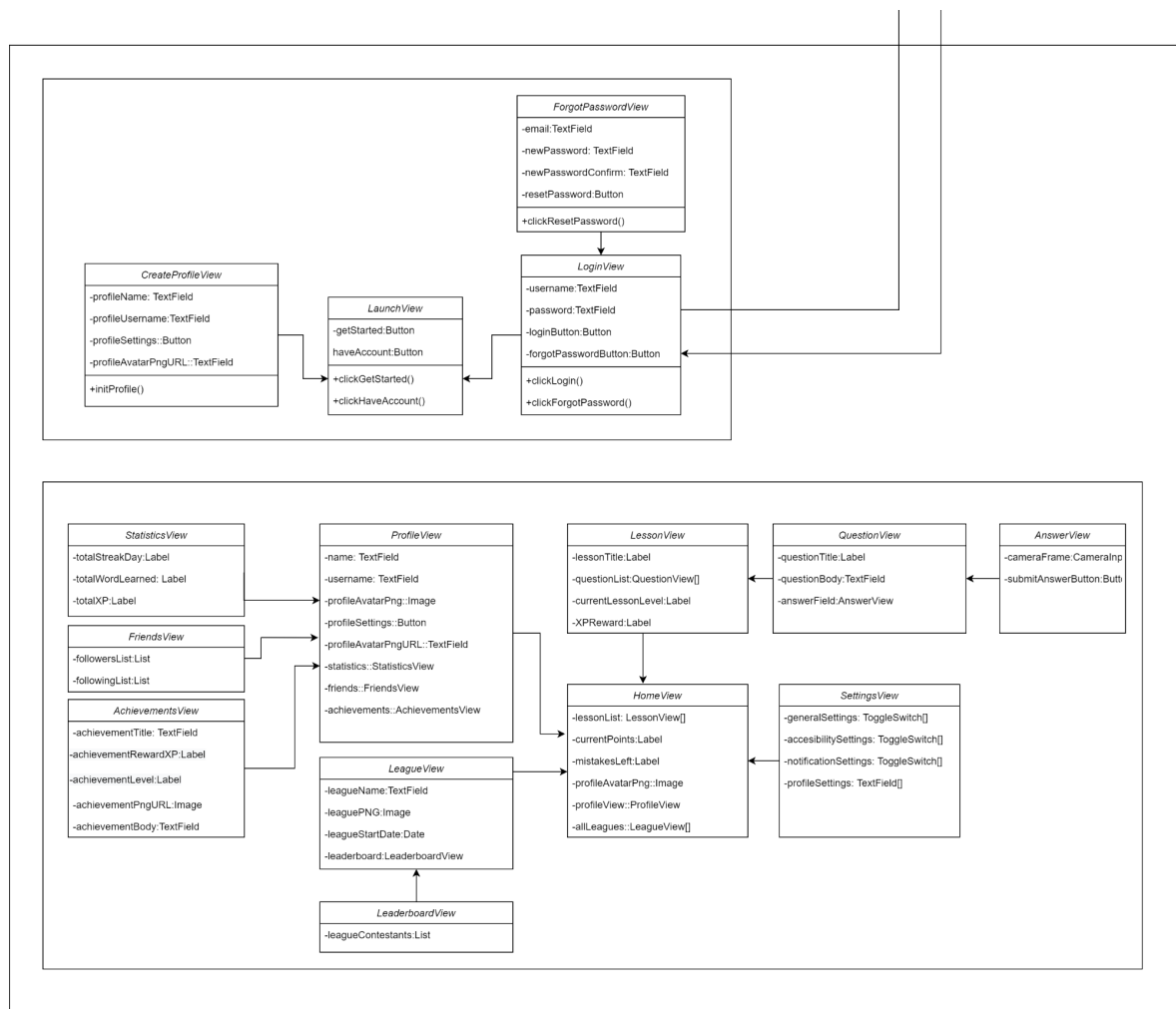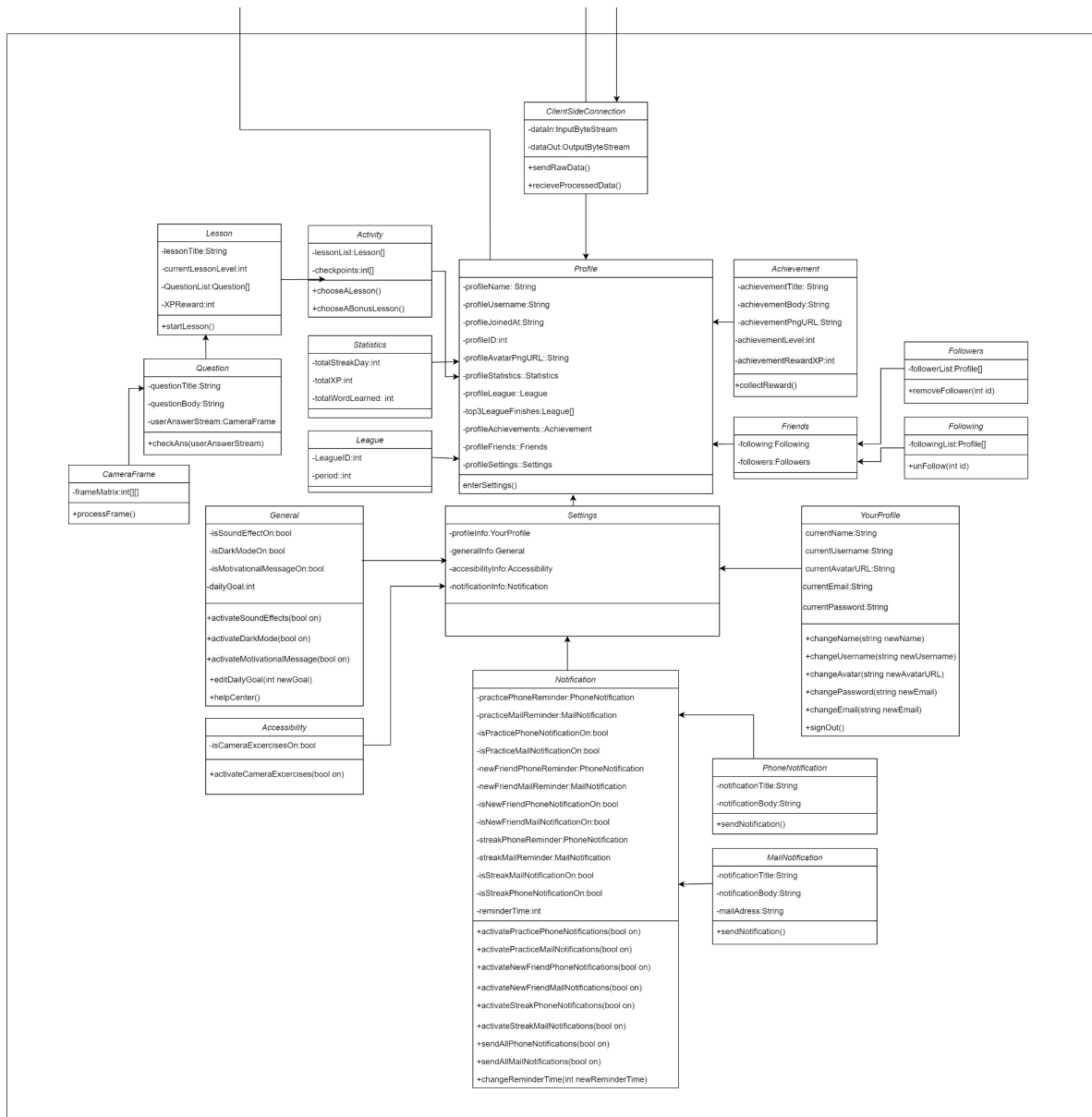- -mailAdress:String
- +sendNotification()

Figure 2.3: Right Part of Class Diagram (Models)
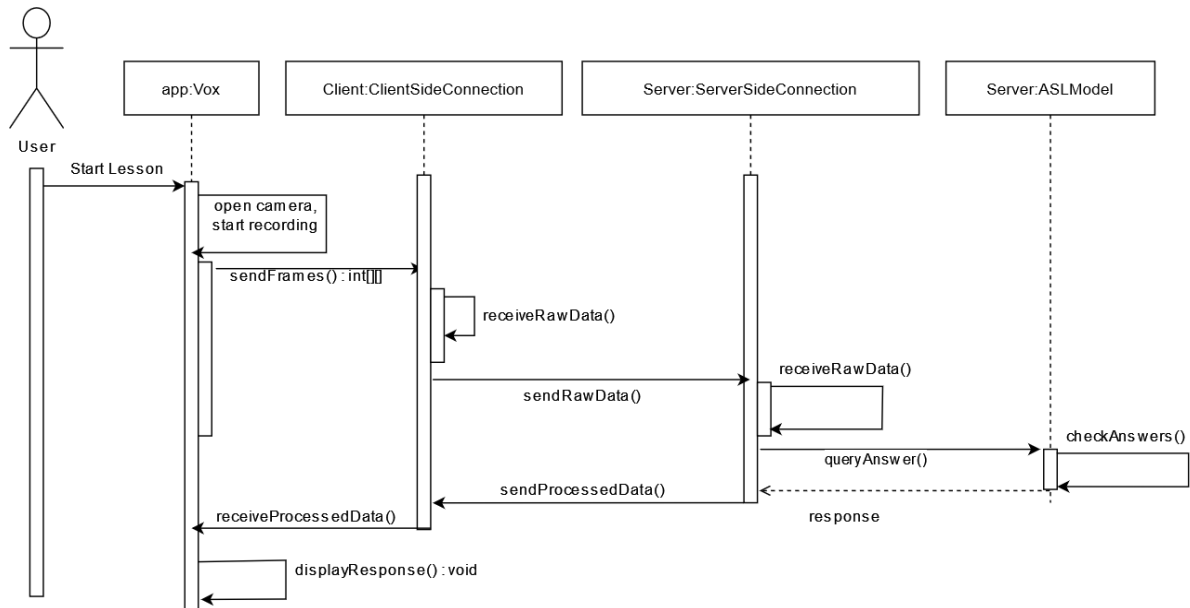
2.5.4 Dynamic Models

● **Sequence Diagram:**
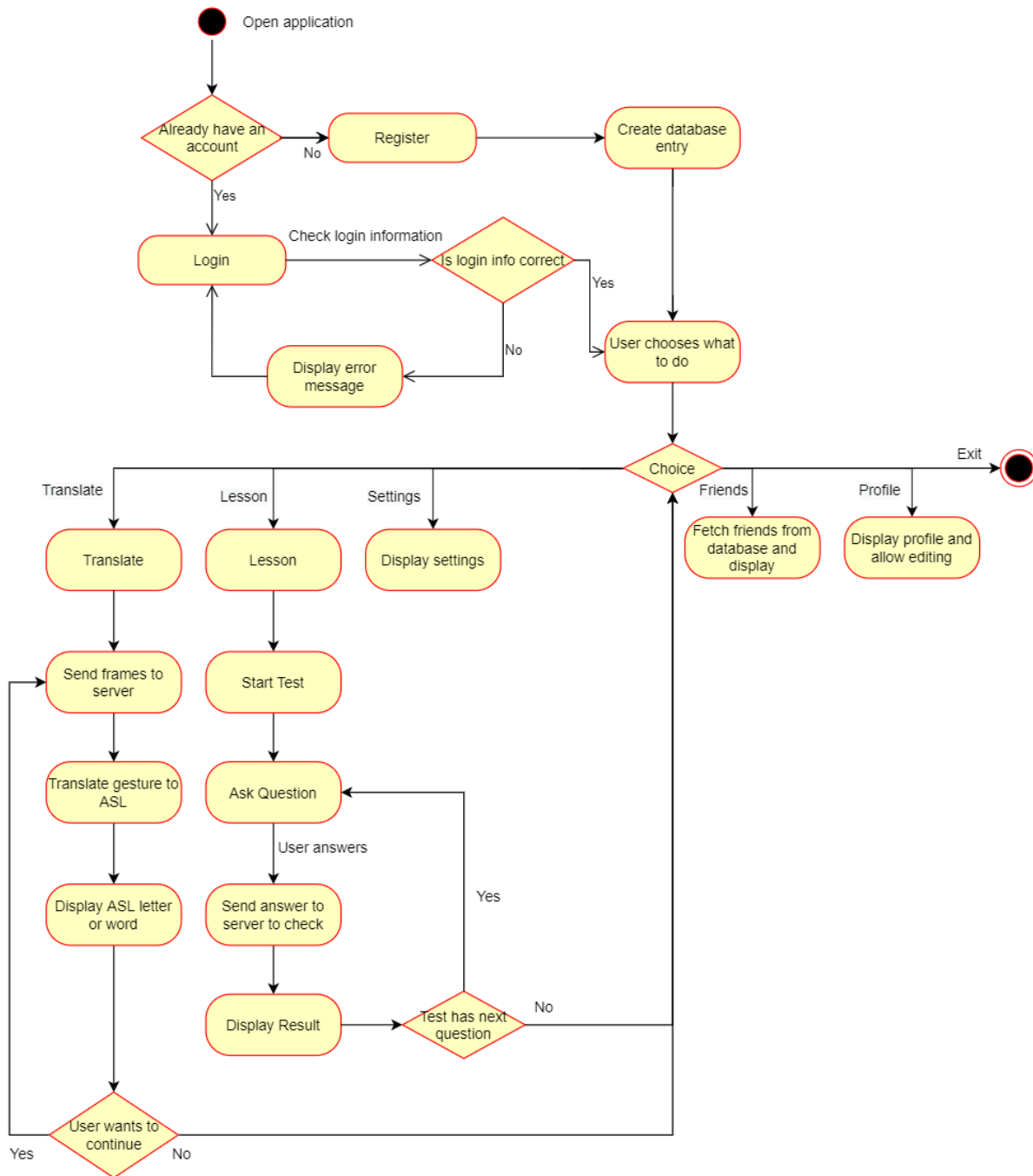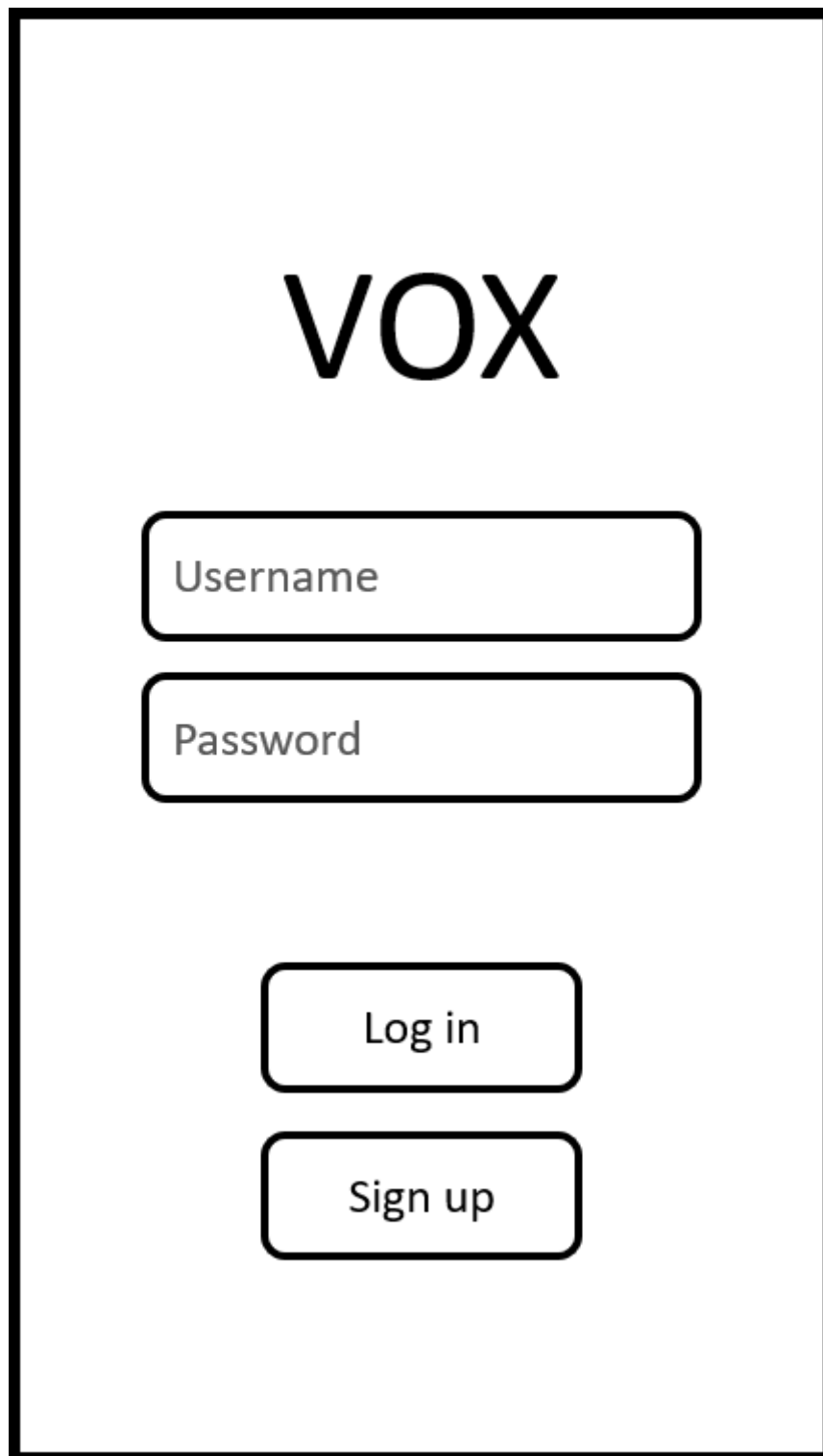

Figure 3: Sequence Diagram

- **Activity Diagram:**

Figure 4: Activity Diagram

2.5.5 User Interface - Navigational Paths and Screen Mocks-ups
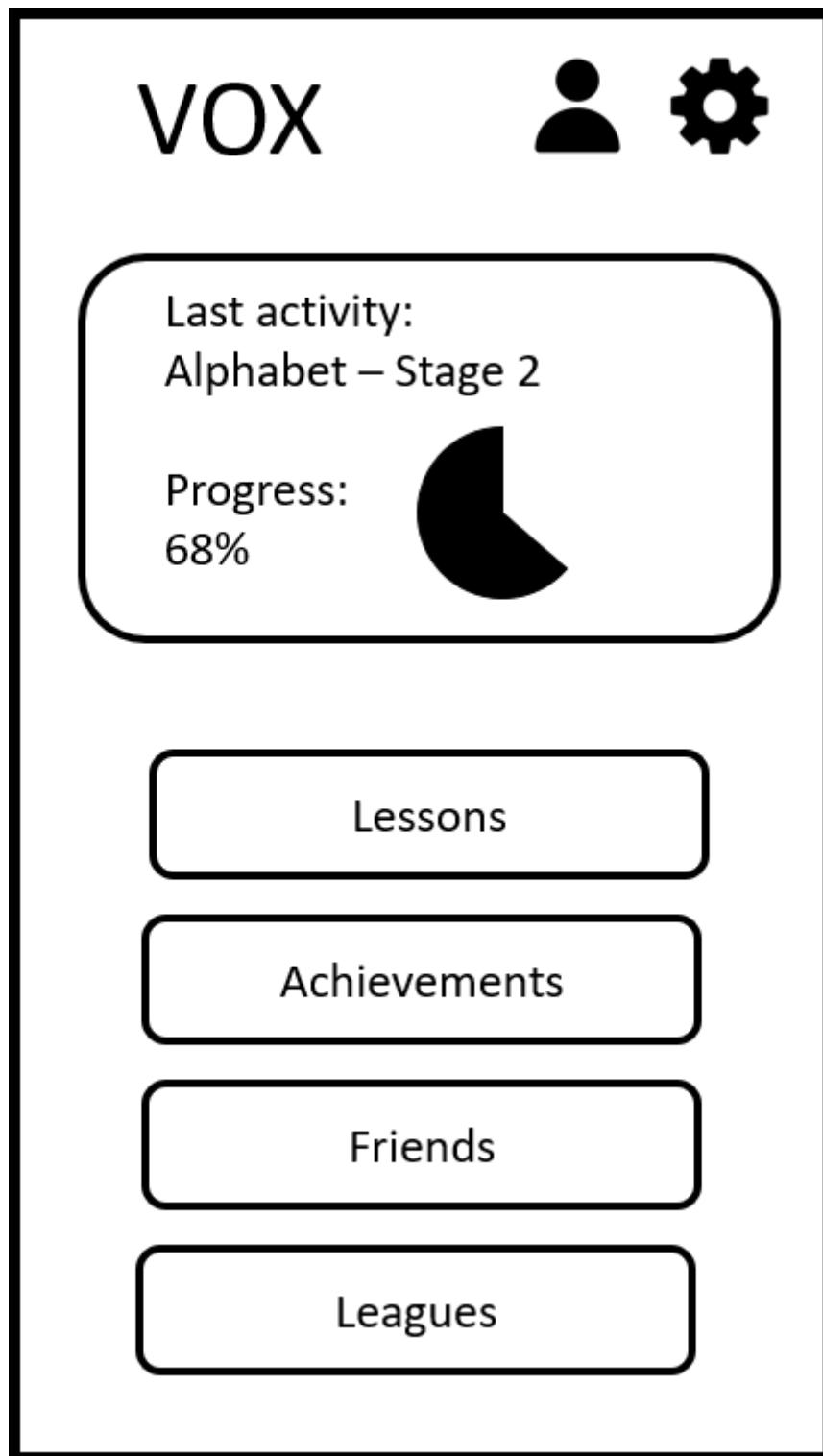

Figure 5: Log In screen
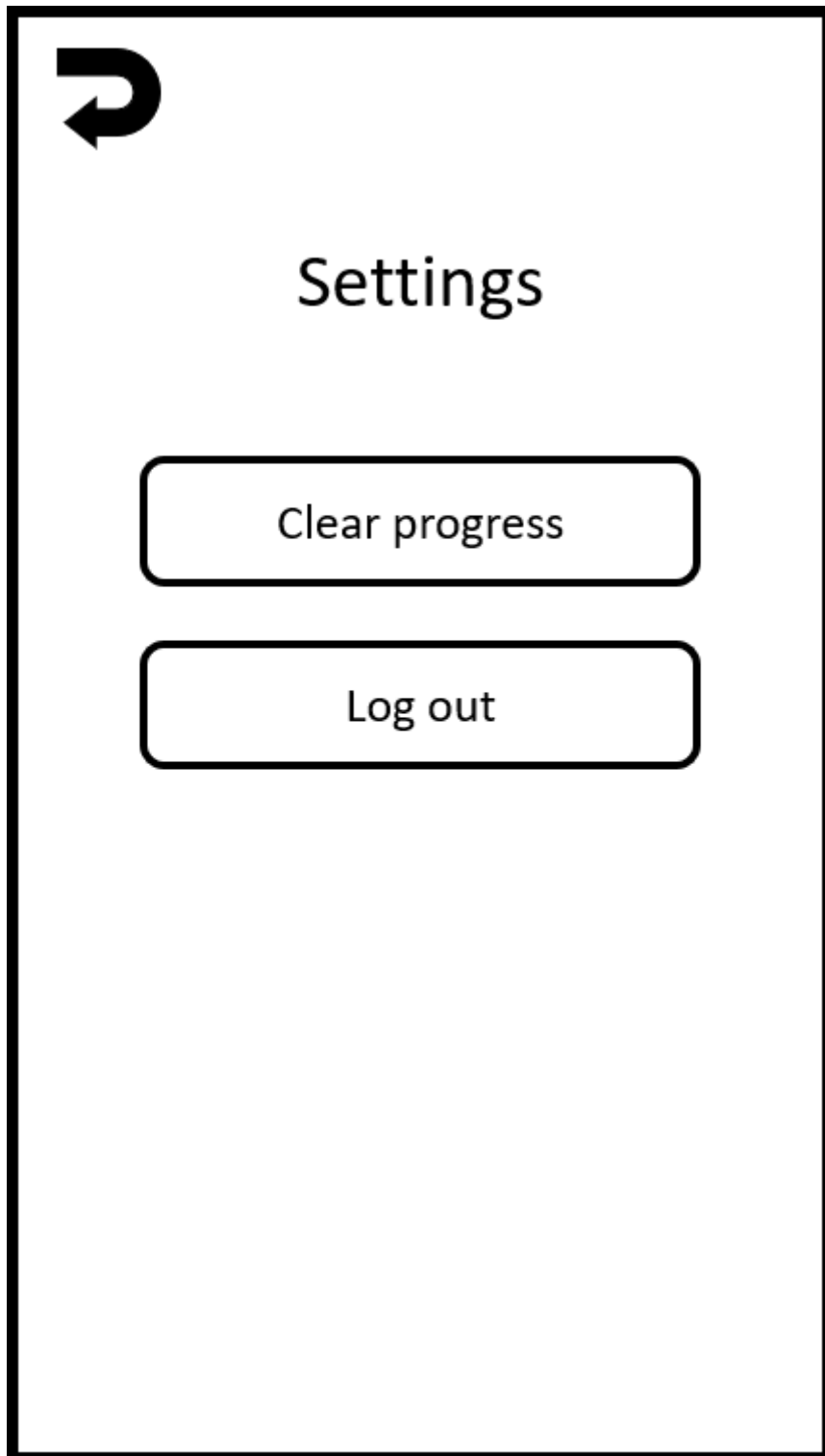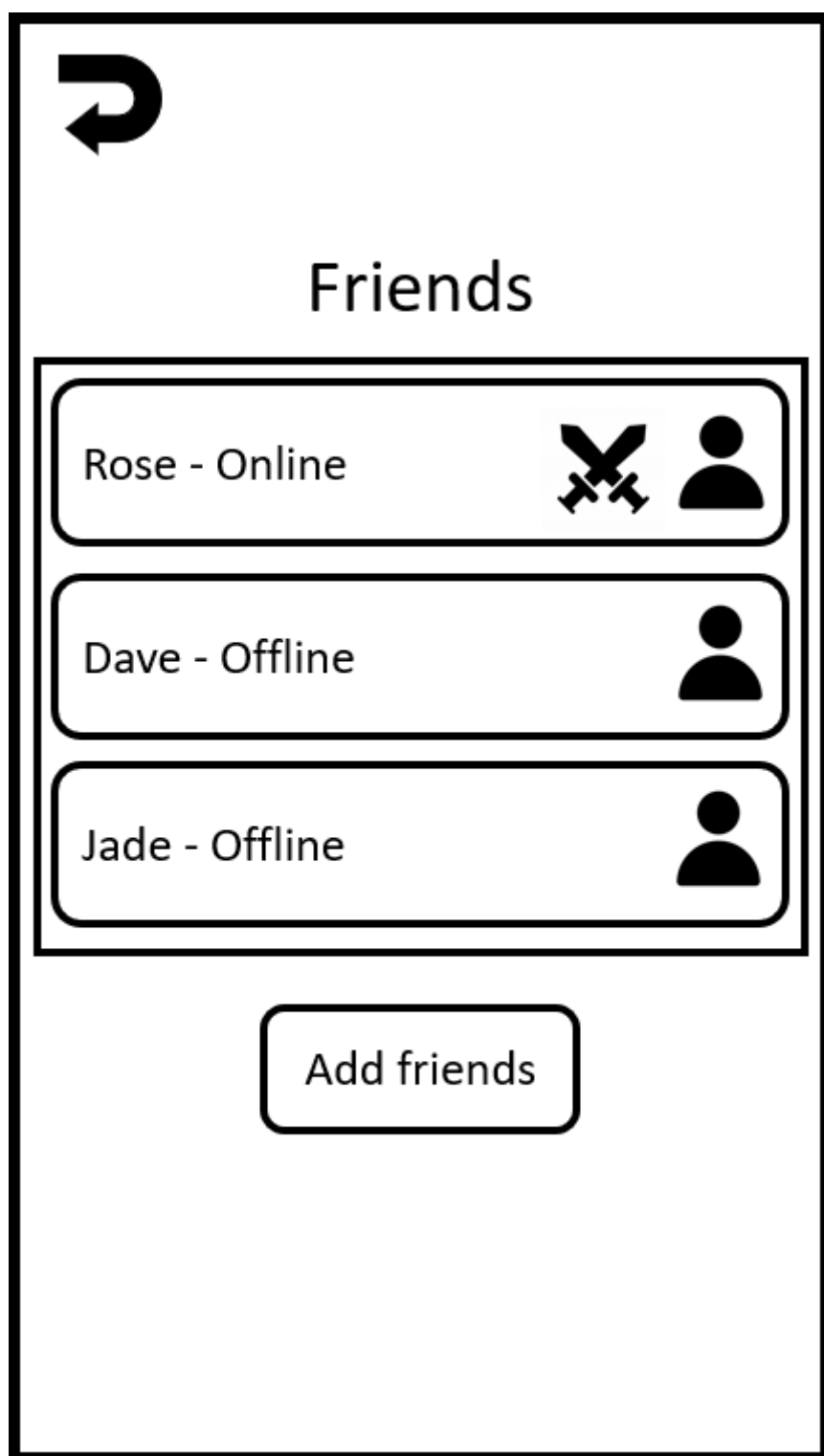
Figure 6: Main Screen

Figure 7: Settings Screen

Figure 8: Friends Screen

Profile

Username: John
Completion: 33%
Longest Streak: 19 days
League: Silver
Number of words learned: 57

Figure 9: Profile Screen

Figure 10: Achievements Screen
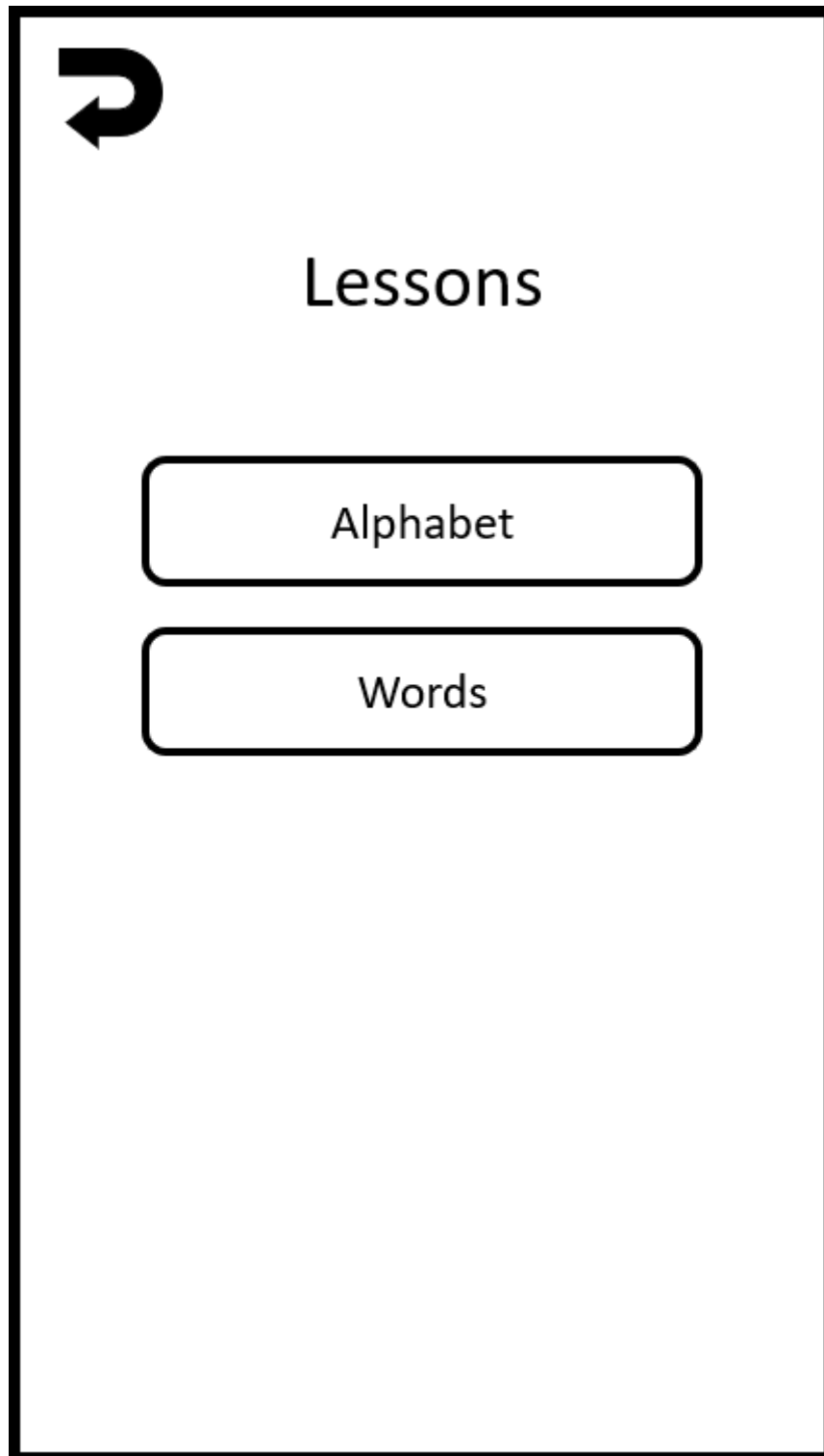
Figure 11: Lessons Screen

Figure 12: Stage Screen

Alphabet – Stage 1

Try signing the letter A

Prompt

User's Camera

Figure 13: Ongoing Lesson Screen

Words – Stage 3

Try signing this sentence:

I like apples.

User's Camera

Figure 14: Ongoing Lesson Screen

3 Other Analysis Elements

3.1 Consideration of Various Factors in Engineering Design

- **Public Health**
  In terms of public health, the application is not likely to have major effects. Since the functionalities of the app are not associated with any health concerns, any outcomes related to the health of the users using the app can be expected to be the minor side effects of certain users using it rather than the expected results for the user base in general. These minor side effects can emerge due to being physically active while using sign language.

- **Public Safety**
  It would be expected and desired for the application's usage to have no effects on public safety in an ideal situation. However, if certain errors, oversights and/or shortcomings with the privacy and security measures of the program end up emerging, such as the user's facial features being leaked, the safety of the users in public may become jeopardized.

- **Economic Factors**
  Sign language may prove to be a useful tool to utilize for marketing and transactional operations in the micro-scale. While it may not seem as a necessity due to the existence of subtitles and similar text-based assistance found in most brand advertisements, small businesses such as restaurants can find significant use in training their employees to learn sign language so that they can communicate better with some of their potential customers if needed, potentially raising their sales. Thus, the application may have a positive effect on the economic circumstances of such businesses.

- **Cultural Factors**
  The cultural impact of the application will probably be one of the more significant wide-scale outcomes of the application, and this significance will keep increasing as more users teach themselves sign language using the application. One of the most important characteristics of an inclusive and socially just culture is that they can provide equal rights and opportunities for all of their members. As expected, one of the key components of this characteristic is to make it as easy as possible for people with disabilities to live their lives with as little difficulties as those without the same disabilities. With the communication barrier that the deaf community faces on a daily basis being slowly lifted thanks to more and more users of the application becoming proficient sign language users, the effects of it on culture will be highly positive.

- **Environmental Factors**
  It is not likely that the application will have any effects on the environment.

- **Global Factors**
  When the topic of globalization is brought up, language barriers are commonly regarded as one of the most significant barriers to cross, especially considering how easy it is for two people on the opposite sides of the world to connect with each other once this barrier is crossed. While the barriers between verbal languages usually come to mind first in these discussions, it is not difficult to estimate that it is likely for sign language barriers to also affect global communication, even if to a smaller extent. With the application helping its users cross this barrier, it will certainly have a positive effect on globalization.

3.2 Risks and Alternatives

Possible Risks and Their Outcomes	Suggested Alternatives
Developer Turnover: As a result of many possible conditions such as withdrawing the course, a developer might leave the group. This would put the rest of the developers in a tough situation as finding a new group member after this event would not be possible.	Explaining the situation to their supervisor, the remaining group members may reduce the negative effects of the turnover to a minimum by following the advice they receive. Using both their own intuition and their supervisor's expertise, the rest of the group can redistribute the work among themselves accordingly.
Lack of Resources: Resources could be both monetary and educational. Certain services may require investing money into, while some concepts may require for the team to seek out tutorials or lectures on them. If any of these resources prove to be scarce, it may force the group to change their tools and strategies in the middle of development.	Before the implementation, the developers should do extensive research on what set of tools and skills will be needed for their implementation strategy, and should prepare a budget and a roadmap based on their findings.
Lack of Productivity: The team members may lose their motivation as a result of many possible reasons such as the difficulty and workload of other courses or emotional turmoil. This can highly reduce the productivity of the group, making it harder for them to finish their work towards the end of the deadline.	The group members should be ready to provide each other emotional support and motivation when needed. At times, a member may also have to put in some extra effort to compensate for one of their demoralized friends' lack of productivity, with the condition of being repaid for it the next time. A group is only as strong as the bonds between their members.

Poor Planning: While implementing the project, it is highly likely for the developers to realize that there were shortcomings in their planning. These can be found in the project specifications, requirements, constraints and/or models. This can force the developers to improvise while implementing some features, causing them to lose time.	The team should meet immediately and work together to come up with a new plan quickly, and possibly contact their supervisor to ask for their advice as well.
Lack of Communication: The developers may neglect maintaining proper communication for a while, causing the group to work asynchronously.	The team should have regular meetings to ensure that each member is informed by the progress of other members and informs the other members of their progress often.
Wrong Choice of Technologies and Tools: The team may decide upon using inappropriate tools and technologies for the implementation. This can cause a significant amount of their time to be lost in the middle of the implementation process.	The team should begin the implementation as soon as they can to minimize the potential damage of realizing that the technologies that were chosen for the implementation were not appropriate for the work to be done.

Table 1: Risks and Alternatives

3.3 Project Plan

Main Deliverables:
- Deliverable 1: Project Specification Report
- Deliverable 2: Project Website
- Deliverable 3: Analysis Report
- Deliverable 4: High Level Design Report
- Deliverable 5: Presentation and Demo (CS491)
- Deliverable 6: Low Level Design Report
- Deliverable 7: Mobile Application
- Deliverable 8: Final Report
- Deliverable 9: Final Presentation and Demo (CS492)
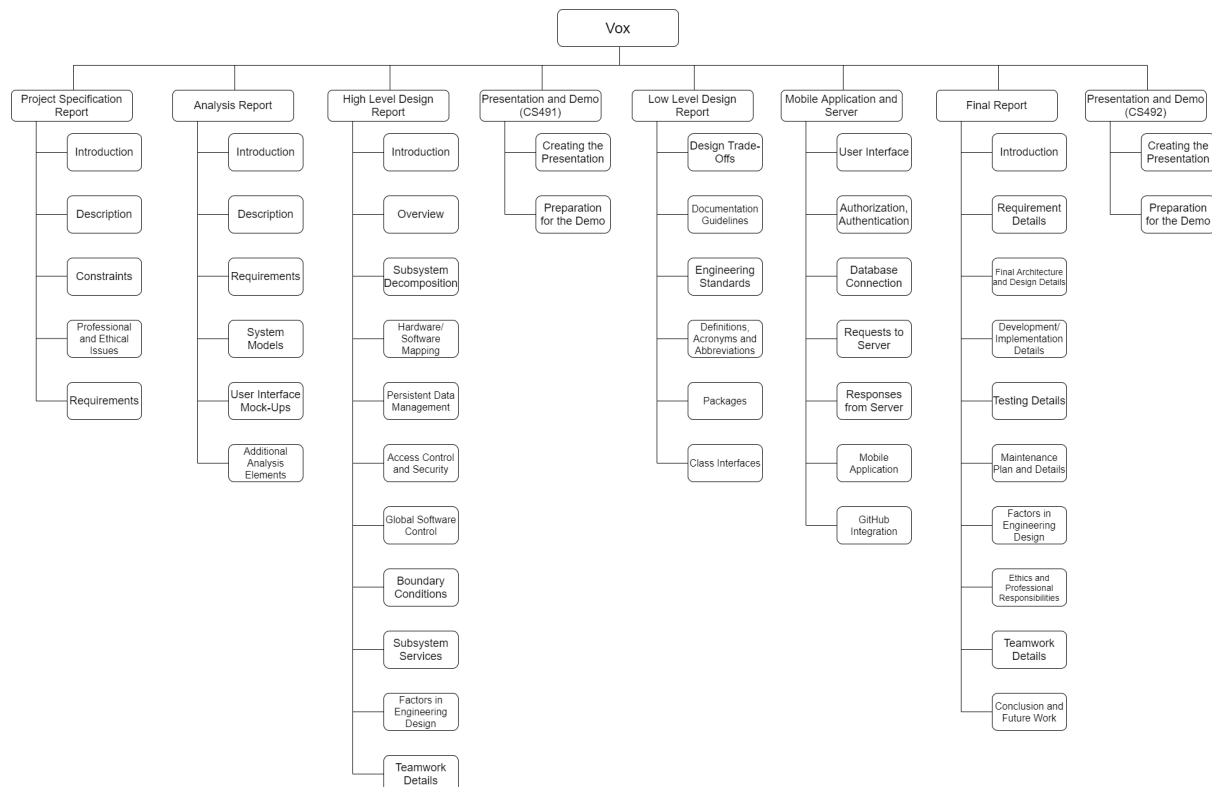
Work Breakdown Structure:

Figure: Work Breakdown Structure

Work Package Details:

Work Package Name: Project Specification Report
Start Date: 07.10.2021
End Date: 11.10.2021
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a report that provides an overview of the planned project and specifies the constraints and requirements of the proposed system.
Subtasks:

- **Introduction:** Introducing the problem that the project aims to provide a solution for in detail.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin
- **Description:** Providing an overview of the proposed system.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin
- **Constraints:** Defining the constraints that are to be taken into account while developing the project.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin
- **Professional and Ethical Issues:** Specifying what the ethical and professional concerns of the developers should be while working on the project.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam

- **Requirements:** Describing the functional and non-functional requirements of the proposed system.
  Members Assigned: Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya

Work Package Name: Project Website
Start Date: 07.10.2021
End Date: 11.10.2021
Members Involved: Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a GitHub.io website that the project repository and reports can be accessed from, as well as the names of the group members and the project.
Subtasks:
- **Backend:** Preparing the backend of the website.
  Members Assigned: Oğulcan Çetinkaya, Sarp Ulaş Kaya
- **Frontend:** Preparing the frontend of the website.
  Members Assigned: Oğulcan Çetinkaya, Sarp Ulaş Kaya

Work Package Name: Analysis Report
Start Date: 06.11.2021
End Date: 15.11.2021
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a report that provides an overview of the planned project, presents the requirements and the system models of the proposed system, shows user interface mock-ups and describes any additional analysis elements.
Subtasks:
- **Introduction:** Introducing the problem that the project aims to provide a solution for in detail.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin
- **Overview:** Providing a detailed description of the proposed system.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin, Sarp Ulaş Kaya
- **Requirements:** Describing the functional requirements, non-functional requirements and pseudo-requirements of the proposed system.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
- **System Models:** Preparing the system model, which includes the use-case, object class model, sequence and activity diagrams, along with several specific use-case scenarios.
  Members Assigned: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
- **User Interface Mock-Ups:** Preparing mock-ups for the expected user interface of the finished project.
  Members Assigned: Atakan Sağlam
- **Additional Analysis Elements:** Description of the various global, economic, cultural and environmental factors to take into consideration during

development, possible risks that may emerge during development and alternative solutions to them, development plan, and the strategy for ensuring proper teamwork, following ethical and professional responsibilities and planning for new knowledge and learning strategies.

Members Assigned: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya

Work Package Name: High Level Design Report
Start Date: TBD
End Date: 24.11.2021
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a report that provides a description of the high-level design structure of the proposed system, which includes subsystem decomposition, persistent data management, access control and security, global software control, boundary conditions, subsystem services and engineering design factors.
Subtasks:

- **Introduction:** Introducing the problem that the project aims to provide a solution for in detail.
  Members Assigned: TBD
- **Overview:** Providing a detailed description of the proposed system.
  Members Assigned: TBD
- **Subsystem Decomposition:** Preparing a detailed diagram of the system decomposed into its subsystem components.
  Members Assigned: TBD
- **Hardware/Software Mapping:** Mapping the relations and communications between the hardware and software components of the system and showing the results on a detailed diagram.
  Members Assigned: TBD
- **Persistent Data Management:** Preparing a detailed description of the strategies to be used in maintaining and managing the flow of data between the components of the system and showing the mapping of these strategies on a diagram.
  Members Assigned: TBD
- **Access Control and Security:** Describing the strategies to be used in managing the ability for the appropriate users to access the appropriate functionalities of the application, along with any additional security measures to be implemented.
  Members Assigned: TBD
- **Global Software Control:** Providing a detailed description of the total decomposition of the software development process and showing it on a diagram.
  Members Assigned: TBD

- **Boundary Conditions:** Specifying the boundaries within which the software development process is to be continued by taking into account what sort of conditions may emerge as a result of these boundaries.
  Members Assigned: TBD
- **Subsystem Services:** Explaining the services to be provided by the various subsystem components and showing it on a detailed diagram.
  Members Assigned: TBD
- **Engineering Design Factors:** Listing the various common factors of the engineering design process to be taken into consideration during the project's development.
  Members Assigned: TBD
- **Teamwork Details:** Giving the necessary details on how the team manages to work as a functioning whole, such as how the workload is split, and how appropriate congruity is established among the members on collaborative steps.
  Members Assigned: TBD

Work Package Name: Presentation and Demo (CS491)
Start Date: TBD
End Date: TBD
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a presentation and getting ready for the demo stage of CS491.
Subtasks:
- **Creating the Presentation:** Preparing a presentation to introduce the project and describe what will be shown in the demo along with how they were implemented, using appropriate tools such as MS PowerPoint.
  Members Assigned: TBD
- **Preparation for the Demo:** Planning on how the different components and functionalities of what's been implemented will be demonstrated, by which member of the group, and in which order.
  Members Assigned: TBD

Work Package Name: Low Level Design Report
Start Date: TBD
End Date: TBD
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a report that provides a description of the low-level design structure of the proposed system, which includes design trade-offs, documentation guidelines, engineering standards, definitions, acronyms, abbreviations, packages and class interfaces.
Subtasks:

- **Design Trade-Offs:** Discussing the possible advantages and disadvantages of the various design strategies, methods and patterns to be used during the implementation of the system.
  Members Assigned: TBD
- **Documentation Guidelines:** Listing the guidelines to follow while preparing the documentation for the project.
  Members Assigned: TBD
- **Engineering Standards:** Discussing the appropriate set of rules and standards in engineering to follow during the project's development.
  Members Assigned: TBD
- **Definitions, Acronyms and Abbreviations:** Listing and describing the necessary definitions, acronyms and abbreviations that are included in or related to the project.
  Members Assigned: TBD
- **Packages:** Listing all of the various external packages that are used and/or to be used in the implementation process, and explaining what each of them are used for and why they are chosen instead of other packages with similar functionalities.
  Members Assigned: TBD
- **Class Interfaces:** Defining the class interfaces that are used and/or to be used in the project, along with the detailed explanations for each of them on what they are used for and how they work.
  Members Assigned: TBD

Work Package Name: Mobile Application and Server
Start Date: TBD
End Date: TBD
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Implementing the proposed system described in the reports by following the specified requirements, constraints and system models in the form of a mobile application and a server that it is connected to.
Subtasks:
- **User Interface:** Designing a clean and easily readable user interface that will allow the users to easily navigate through the functionalities of the application and implementing it.
  Members Assigned: TBD
- **Authorization and Authentication:** Implementing a sign-up and login system that will authorize and authenticate the users based on their account details.
  Members Assigned: TBD
- **Database Connection:** Setting up database components on the server using SQL to create and manage the appropriate entities and relations, followed up by establishing the necessary connections between them and the server components.

Members Assigned: TBD

- **Requests to the Server:** Implementing a system to allow sending requests to the server from the mobile application.
  Members Assigned: TBD
- **Responses from the Server:** Implementing a system to allow the mobile application to receive the responses to its requests from the server.
  Members Assigned: TBD
- **Mobile Application:** Implementing a mobile application that will send the requests corresponding to its user's inputs to the server and receive the correct responses from the server to show to its users.
  Members Assigned: TBD
- **GitHub Integration:** Integrating the project to GitHub to maintain and manage team coordination and collaboration while also providing version control for the code.
  Members Assigned: TBD

Work Package Name: Final Report
Start Date: TBD
End Date: TBD
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a report that provides a description of the finished project and its development process, which includes the requirement details, final architecture and design details, development and implementation details, testing details, maintenance plan and details, factors in engineering design, ethics and professional responsibilities, teamwork details, conclusions and future work.
Subtasks:
- **Introduction:** Introducing the problem that the project aims to provide a solution for in detail, and how it provides it.
  Members Assigned: TBD
- **Requirement Details:** Listing the functional requirements, non-functional requirements and pseudo-requirements that were followed during the development process in detail.
  Members Assigned: TBD
- **Final Architecture and Design Details:** Providing a detailed description of the architecture and design of the finished project by using diagrams and providing the necessary explanations for them and their components.
  Members Assigned: TBD
- **Development and Implementation Details:** Providing a detailed explanation of the development and implementation process that the developers of the project went through to finish it.
  Members Assigned: TBD
- **Testing Details:** Providing details on the testing process that the developers of the project used to find the various errors and issues and fix them.

Members Assigned: TBD
- **Maintenance Plan and Details:** Preparing a detailed plan to maintain and manage the services and functionalities of the project in the future.
Members Assigned: TBD
- **Engineering Design Factors:** Listing the various common factors of the engineering design process that were taken into consideration during the project's development.
Members Assigned: TBD
- **Ethics and Professional Responsibilities:** Specifying what the ethical and professional concerns of the developers were while working on the project, and how they took them into account during development.
Members Assigned: TBD
- **Teamwork Details:** Giving the necessary details on how the team managed to work as a functioning whole throughout the development process, such as how the workload was split, and how appropriate congruity was established among the members on collaborative steps.
Members Assigned: TBD
- **Conclusion and Future Work:** Giving out a brief conclusion of the development process, describing what lessons were learned and what experiences were gained while working on the project, followed by the future work planned for the project and its developers.
Members Assigned: TBD

Work Package Name: Final Presentation and Demo (CS492)
Start Date: TBD
End Date: TBD
Members Involved: Furkan Başkaya, Berk Kerem Berçin, Atakan Sağlam, Oğulcan Çetinkaya, Sarp Ulaş Kaya
Objective: Preparing a presentation and getting ready for the demo stage of CS492.
Subtasks:
- **Creating the Presentation:** Preparing a presentation to introduce the project and describe what will be shown in the demo along with how they were implemented, using appropriate tools such as MS PowerPoint.
Members Assigned: TBD
- **Preparation for the Demo:** Planning on how the different components and functionalities of the final project will be demonstrated, by which member of the group, and in which order.
Members Assigned: TBD

3.4 Ensuring Proper Teamwork

As described in the previous sections, there are numerous practices we are planning to adopt while developing our project to create the proper working conditions for establishing proper communications and congruity within the team to

ensure effective work distribution and collaboration. Regular meetings throughout the development process will be essential to this goal as well as maintaining a balanced distribution of workload among the team members, which will be achieved by using GitHub and Jira for managing team coordination and providing the necessary environments for collaborations and version control. While professionalism will be the key in achieving a high-quality final product, the genuine bonds between the team members will be just as helpful in motivating everyone to work with each other and in unison. This is why it will be crucial for us to not only help each other with the work when necessary, but to also provide emotional and motivational support for each other when it's needed.

3.5 Ethics and Professional Responsibilities

It will be important for us to develop the project in a closed-source environment for ethical reasons as external help for the development process is both illegal for the course and untrustworthy. Additionally, we will have several ethical and professional responsibilities with the user data. Without any permission from the users, we will not be sharing their data with a third party under any circumstance, and the video footage provided by the user and the response from the server will both be encrypted to make sure that they are not shared with anyone but the user themselves.

3.6 Planning for New Knowledge and Learning Strategies

We will not be staying loyal to a certain set of knowledge and a handful of learning strategies whether or not they prove to be useful for a certain stage of the project's development. To be as efficient as possible throughout the entire development process, it will be crucial for us to adapt to using new knowledge and learning strategies if they prove to be more effective than what we've been utilizing up to that point. The key to applying new knowledge and learning strategies as needed will be staying flexible, and always being open to new ideas, utilities and learning methods.

4 Glossary

ASL: American Sign Language
SQL: Structured Query Language
Vox: The name of our application, which translates to "voice" in Latin

5 References

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