CS 491
Senior Design Project

Analysis Report

Project Name: UThere

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1. Introduction

Developments in technology have been reshaping the way humans communicate with each other for a long time. Video conferencing is one of the most recent and widely used real-time communication types. There are different uses of video conferencing. It is widely used by companies that have remote workers or multiple offices. Another usage of video conferencing is for educational purposes such as workshops, training, university lectures, etc. It provides many benefits such as reducing travel expenses, increasing productivity and time efficiency, and promoting collaboration for individuals and businesses [1].

While providing these benefits, video conferencing has the drawback of limited personal interactions [2]. Due to this limitation, the attention span of the participants tends to decrease during online meetings. During face-to-face meetings, it is possible for presenters to observe their audience's facial expressions and respond accordingly. By scanning the room, narrators can use different techniques to grab others' attention when needed. However, it is not easy to examine all the faces during a video conference, which is the main problem we want to provide our innovative solution.

Other than tracking the audience's attention, there might be other aspects that presenters may want to track. One thing that presenters may want to know is which part of their presentation took more attention. With the help of eye gaze tracking techniques, presenters may be informed about which part of the screen is more eye-catching. This can be beneficial for them to improve their presentation content over time. For example, if images and graphs are more catchy than the textual content, they may prefer to use them more.

In addition to these, presenters might want to be aware of the audience's emotional state; such as when they reacted positively, negatively, or stayed neutral. By knowing that, they can adjust themselves to the audience's needs immediately. For instance, if the majority of people react negatively, there might be a need for further explanation. If they stayed neutral during the parts that should create excitement, presenters may want to work on their presentation skills.

Online meetings have various challenges and online presenters have several needs. These needs can be met by a video conferencing tool that adopts the latest machine learning techniques to track and analyze the audience.

2. Current System

In the market, there are various video-conferencing applications such as Zoom, Google Meet, Microsoft Teams, etc. These platforms offer virtual face-to-face conversations where facial expressions can be seen. However, while presenting, it can be nontrivial to follow the audience.

After detailed research is done, more similar applications are found. Comparing them to our project, the most related application is Spiky.ai which was established in 2020 [3]. It analyzes the sentiment of the users according to 48 different engagement metrics. Spiky.ai can be

integrated into some popular applications such as Zoom, Microsoft Teams, Google Meet, Webex, etc. The other way of usage is uploading the video that will be analyzed [4].

However, in our project, the aim is to offer a video-conferencing application which analyzes the emotion and attention level of the participants. The analysis will be done by using the data obtained through the videos of the participants. The most significant difference of our project is providing real-time attention level of the participants. Therefore, our application not only provides long-term development but also gives the chance to fix the presenter's problems during the presentation.

3. Proposed System

3.1 Overview

UThere is a video conferencing web application with various audience tracking and analysis features. The main aim of this web application is to improve the attention span of the audience by providing instant feedback to the presenters during online meetings. The application will monitor the audience's faces and analyze their attention rates. For people using a single monitor, it will track whether they are looking at the screen or not. UThere will notify the presenters about the attention status of the audience in real time. So that, presenters will be able to arrange themselves as they would be able to do in face-to-face meetings. With the help of the latest techniques in machine learning, the application will be able to provide a more human interaction friendly online meeting experience. UThere aims to break the taboo in people's minds that online meetings are often boring and monotonous.

The application will also turn the audience's real-time videos into an advantage for presenters with eye gaze tracking and emotion tracking features. By analyzing the audience's reactions to the presenters, it will be possible to gain insight on things that would stay unnoticed during face-to-face meetings. Presenters will be notified about how the majority of people react and whether they are staying neutral, positive, or negative towards what is being presented.

Normally, it is less possible to keep track of who is paying attention and who is not and to find out the correlation between audience profiles and their attention spans. UThere will also explore these correlations by conducting data analysis on attention span information and user profiles.

When the distinguishing functionalities of UThere are considered, it can be suggested that the type of innovation that will be implemented is Product Performance [5]. The innovation that we want to bring is incremental, we want to improve existing video conferencing tools with new features. This improvement is crucial due to the transformation of communication platforms and practices.

3.2 Functional Requirements

3.2.1 User

- The user can register to the video-conferencing app and create a profile.
- The user can sign in to the system.
- The user can allow the system to use the camera and microphone.
- The user can mute/unmute himself/herself.
- The user can open and close his/her camera.
- The user can view all the participants in the meeting.
- The user can fill out the contact form to get help.
- The user can raise a hand or send emojis.
- The user can edit his/her profile.
- The user can set analysis preferences such as attention rate limit, hiding emotion analysis and hiding attention analysis.
- The user can sign out.
- The user can be the host, presenter or audience in the meeting.

3.2.1.1 Host

- The host can start a meeting and copy the meeting ID to share with others.
- The host can end the meeting.
- The host can set/unset the presenter.
- The host can remove a participant from the meeting.
- The host can share the analysis report formed at the end of the meeting with the participants whom he/she selects.
- The host can access the real-time report indicating the attention level and emotional status of the participants.
- The host can answer the poll created by the presenter.
- At the end of the presentation, a report displaying the overall attention rate and emotional status of the participants is formed and shared with the host.

3.2.1.2 Presenter

- The presenter can join the meeting by using the meeting ID that is provided by the host.
- The presenter can leave the meeting.
- The presenter can share a screen.
- The presenter can access the real-time report indicating the attention level and emotional status of the participants.
- The presenter can send an alert to the selected participants.

- The presenter can create a poll and share it with the participants in order to increase the attention rate.
- The presenter is notified about who left the meeting.
- Before the presentation, the presenter can set an attention limit which the presenter is warned of when the attention rate of the participants goes down below.
- The presenter can see the analysis report that is formed at the end of the meeting if the host of that presentation shares it with him/her.
- The presenter can end the poll.

3.2.1.3 Audience

- The audience can join a meeting by using the meeting ID that is provided by the host.
- The audience can leave the meeting.
- The audience can answer the poll created by the presenter.

3.3 Nonfunctional Requirements

3.3.1 Usability

- The user interface will be simple and provide quick access to essential features of the application. The design of the website will require minimal explanation to understand how to use it.
- Any user who knows how to use any video-conferencing application will be able to use UThere.
- The user can contact us to get help by filling the online contact form.

3.3.2 Privacy

- The collected personal data from the users such as their camera records will be only used for attention and emotion tracking. These personal data will not be processed for any other purposes which are incompatible with the main purposes of UThere.
- UThere will process the personal data of the user on the condition that users consent to such processing. The provided consent form will be specific, informed and explicit.
- The user’s face record or video records will not be kept in the database.

3.3.3 Scalability

- UThere will be scalable in terms of the ability to handle increased workloads such as adding users more than 5 to a meeting if required hardware and software equipment are supplied.

3.3.4 Performance

- UThere will be a real-time system which processes the faces of the users and presents the current attention level to the presenter.
- The system can process at most 5 users' faces within a minimized time lag between the time when data is produced and the time when data is processed.
- The attention level of the presentation should have high accuracy.

3.3.5 Robustness

- The system will not crash under disturbances such as invalid or erroneous input by dealing with these stressful environmental conditions.

3.3.6 Extensibility

- The design and implementation of the system will not hinder future needs and updates of the system.
- The functionality of the project can be expanded in the future such as sleep detection, and specific emotion recognitions such as aggression, excitement, etc.
- The system will be implemented as object-oriented. Therefore, it will be easy to extend the system for future needs and requirements.

3.4 Pseudo Requirements

3.4.1 Implementation Constraints

- Version control will be conducted via Git on Github.
- Trello will be used as the project management tool.
- Project will be implemented by using Python, HTML, CSS, Javascript and React.
- Django will be used as the web framework.
- Agora SDK will be used for handling video, voice and other video conferencing features.
- MVC will be used as a software architecture pattern.
- OOP will be used as a programming paradigm.
- Only attendees having an open camera will be evaluated.
- English and Turkish will be supported.
- Cloud servers will be used for real time processing.

- Google Cloud will be used as a cloud system.
- The system will use third-party libraries like OpenCV, Pytorch and TensorFlow.

3.4.2 Economic Constraints

- github.io domain service is free of charge.
- Open source libraries are free of charge.
- Development and testing tools are free of charge.
- Cloud servers will be free of charge.
- Google provides a 12-month free trial with $300 credit to use with any Google Cloud services [6].
- Github repositories are free of charge for student accounts.
- Agora provides a 10.000 minutes free trial for each month and further usage will be charged. 10.000 minutes for a month is satisfactory for the development stage, therefore there will be no cost during the development stage.
- 3.99$ will be charged after deployment for 1000 participant minutes, the payment method will be subscription based [7].

3.4.3 Safety Constraints

- User's information will not be shared with any third party and will only be used to provide feedback.
- Password strength will be checked during registration.

3.4.4 Ethical constraints

- Participants should need to give permission to access cameras.

3.4.5 Environmental Constraints

- Since our project has no connection with the environment, there will be no environmental constraints.

3.4.6 Manufacturability Constraints

- Since our project has no connection with manufacturing, there will be no manufacturability constraint.

3.4.7 Technological constraints

- Demo will only support 4 participants (excluding the presenter) per meeting due to the limitation of processing power at the current stage.
- Device needs to be connected to the internet.
- Device should have an available camera.

- The program will be suitable for different platforms like Chrome, Firefox, etc.

3.5 System Models

3.5.1 Scenarios

Scenario Name	createAccount
Participating Actor Instances	Alice: Non-User
Flow of Events	1. Alice enters the UThere website. 2. Alice fills in the sign up form. This form has 5 fields: email, password to use in UThere, password verification, name and surname of the user, and terms of service. 3. Since the email she enters is already in use by another user, she is not able to create an UThere account. 4. She enters a different email which is not in use by another user. However, this time the verification password part of the form does not match with the password part. Therefore, the system does not allow her to create an account. 5. She corrects the password verification part to match with the password part. She reads the terms of service and accepts it to create an account.

Scenario Name	signInAccount
Participating Actor Instances	Alice: User
Flow of Events	1. Alice enters the UThere website. 2. Since Alice cannot remember the email she used in the sign up process, she enters the wrong email to the system, the system alerts her by stating “Invalid password or email”. Then, she remembers the email she used in the sign up process and enters it. 3. This time she cannot remember the password and enters the wrong password. The system alerts her again by stating “Invalid password or email”. After she remembers the password, enter in the registration process and uses it, the system allows her to sign in to her account.

Scenario Name	singlePresenterMeetings
Participating Actor	Alice: Host

Instances	Bob: Presenter Jack, Jane: Audience
Flow of Events	1. Alice, Bob, Jack and Jane sign in the UThere system successfully. 2. Alice starts the meeting by pressing the “New Meeting” button on the home page and copies the Meeting ID. She shares the meeting ID with Bob, Jane and Jack. 3. Bob, Jack and Jane try to join the meeting by pressing the “Join Meeting Button” on the home page. Jack and Jane enter the right meeting id and join the meeting. Bob enters the wrong meeting id in his first trial and gets an alert about invalid meeting id. After he enters the right meeting id, the system allows him to join the meeting. 4. When Alice, Bob, Jane and Jack join the meeting, their cameras are turned on and microphones are closed by default. Besides that, all of them are able to view participants. 5. In default, Alice is the presenter of the meeting since she is the host. However, the person who will make the presentation is Bob. Therefore, Alice sets Bob as the presenter. 6. Bob unmutes himself and starts to screen share to show the slides he prepared for this presentation. Then, he starts his presentation. 7. During his presentation, Alice and Bob are able to see participants' real time analysis of attention level by looking at the attention scale component on the screen. However, Jack and Jane cannot see this scale since they are not the presenter or host. 8. During Bob's presentation, Jane and Jack get so bored that it is clear from their faces that they have negative feelings toward this presentation. UThere detects this emotional state of Jane and Jack and alerts Bob by stating that negative feelings are aroused without pointing to any participant. 9. Since Jane gets bored, she starts to look at her cat in her room instead of Bob's presentation. She gets distracted by her cat and this causes a decrease of attention level on scale. UThere shows a warning to the presenter by stating that the attention limit decreases under the threshold of the decided attention limit and offers him to create a poll to increase the attention limit. 10. Since the attention level is still less than the attention threshold, UThere alerts Bob again. 11. Bob creates a poll to increase the attention level of the participants by creating a more interactive presentation. 12. Jane, Jack and Alice answer the poll. Thanks to this poll, their attention level to presentation increases. 13. After Bob finishes his presentation, Alice ends the meeting for all participants. 14. After Alice ends the meeting, UThere asks her whom she wants to share the analysis with. Alice choses Bob since he is the presenter. However, she does not have to choose anyone if she wants. Alice can see the analysis report of the meeting from her profile. 15. Since Alice shared the meeting analysis report with Bob, he can also see the report from his profile.

Scenario Name	multiplePresenterMeetings
Participating Actor Instances	Alice: Host Bob, Angela: Presenter Jack, Jane: Audience
Flow of Events	1. Alice, Bob, Jack, Jane and Angela sign in the UThere system successfully. 2. Angela is directed to the profile page since she presses the “Profile Button” on the home page. Then, she chooses the “Set Analysis Preferences” tab and Angela sets the minimum attention level as 70% she expects when she presents. 3. Alice starts the meeting by pressing the “New Meeting” button on the home page and copies the Meeting ID. She shares the meeting ID with Bob, Jane, Jack and Angela. 4. Bob, Jack, Jane and Angela try to join the meeting by pressing the “Join Meeting Button” on the home page. All of them successfully join the meeting. 5. When Alice, Angela, Bob, Jane and Jack join the meeting, their cameras are turned on and microphones are closed by default. 6. In default, Alice is the presenter of the meeting since she is the host. However, the person who will make the presentation first is Bob. After Bob, Angela will make a presentation. Therefore,Alice unsets herself as the presenter and sets Bob as a presenter firstly. 7. Bob unmutes himself and starts to share a screen to show the slides he prepared for this presentation. Then, he starts his presentation. 8. During his presentation, Bob and Alice are able to see participants' real time analysis of attention level by looking at the attention scale component on the screen. However, Angela, Jack and Jane cannot see this scale since they are not the presenter or host. 9. During Bob's presentation, Jack gets so excited that it is clear from his face that he has positive feelings toward this presentation. UThere detects this emotional state of Jack and alerts Bob by stating that positive feelings are aroused without pointing to any participant. 10. However, at the middle of the presentation, Jane and Jack close their cameras. Then, Jack opens it but Jane leaves the meeting. 11. Bob is informed about Jane’s leaving by pop-up message. 12. After Bob finishes his presentation, Alice unsets Bob as presenter. Since there should be at least one presenter in the meeting, Alice is assigned as a presenter by the system because she is the host. Bob cannot see the attention scale anymore since he is not a presenter anymore. Also he cannot share screen because he is an audience now. 13. Then, Alice sets Angela as presenter. Angela starts her presentation. 14. Towards the end of her presentation, Jack sends a “raise hand emoji” to ask a question. When Angela allows him to speak by verbally stating, he unmutes himself, asks his question and mutes himself back. 15. After Angela finishes her presentation, Alice ends the meeting for all.

	16. After Alice ends the meeting, UThere asks her whom she wants to share the analysis with. Alice choses Bob since he is the presenter. However, she forgets to share with Angela. Alice can see the analysis report of the meeting from her profile and Bob can see the shared analysis report of the meeting from his profile. However, Angela cannot see it because Alice as a host did not share it with her. 17. Alice, Bob, Angela, Jack and Jane sign out.

Scenario Name	groupPresenterMeetings
Participating Actor Instances	Alice: Host Bob, Angela: Presenter Jack, Jane: Audience
Flow of Events	1. Alice, Bob, Jack, Jane and Angela sign in the UThere system successfully. 2. Angela is directed to the profile page since she presses the "Profile Button" on the home page. Then, she chooses the "Set Analysis Preferences" tab and Angela sets the minimum attention level as 50% she expects when she presents. 3. Alice starts the meeting by pressing the "New Meeting" button on the home page and copies the Meeting ID. She shares the meeting ID with Bob, Jane, Jack and Angela. 4. Bob, Jack, Jane and Angela try to join the meeting by pressing the "Join Meeting Button" on the home page. All of them successfully join the meeting. 5. When Alice, Angela, Bob, Jane and Jack join the meeting, their cameras are turned on and microphones are closed by default. 6. In default, Alice is the presenter of the meeting since she is the host. However, Bob and Angela will make the presentation as a group. Therefore, Alice sets Bob and Angela as presenters. 7. Bob unmutes himself and starts to share a screen to show the slides he prepared for this presentation. Then, he starts his presentation. 8. During his presentation, Bob, Angela and Alice are able to see participants' real time analysis of attention level by looking at the attention scale component on the screen. However, Jack and Jane cannot see this scale since they are not the presenter or host. 9. During Bob's presentation, neither Jack nor Jane do not show specific emotions which can be detected as excitement or aggression. Therefore, UThere detects this emotional state of audiences as neutral. 10. After Bob's first part in the presentation, Angela starts her part of the presentation. 11. After Angela finishes her presentation, Bob makes the final part of his presentation. At the end of their group presentation, Alice unsets both of them from the presenter role. Alice ends the meeting for all. 12. After Alice ends the meeting, UThere asks her whom she wants to share the analysis with. Alice choses Bob and Angela since they are

	the presenter. Alice can see the analysis report of the meeting from her profile. Bob and Angela also can see the shared analysis report of the meeting from their own profile. 13. Alice, Bob, Jack and Jane sign out. Angela does not sign out for a long time without performing any activation in the system. Therefore, her sign in process times-out.

Scenario Name	changeAnalysisPreferences
Participating Actor Instances	Alice: User
Flow of Events	1. Alice signs in the UThere system successfully. 2. She has a meeting 15 minutes later. Therefore, before the meeting she wants to change some analysis preferences in UThere. 3. Alice is directed to the profile page since she presses the "Profile Button" on the home page. Then, she chooses the "Set Analysis Preferences" tab. 4. In this tab, she enables the "Hide Emotion Analysis" button since she is not interested in the audience's emotion. 5. Besides that, she enables the "Hide Who Left" button since she does not want to be distracted by this information during the presentation. 6. After this meeting, she had another meeting as an employee in the marketing department in a company. Therefore, she needs the emotion that will be aroused by the product. So, she disables the "Hide Emotion Analysis" button since she is interested in the audience's emotion now. 7. However, for this meeting she does not want to be informed about the attention level of the audience. Therefore, she enables the "Hide Attention Analysis" button since she is not interested in the audience's attention level now. 8. Besides, she thinks that only the emotion report at the end of the meeting will be enough for her. For this reason, she also enables both the "Hide Real Time" button and "Get Report" button.

Scenario Name	getOnlineHelp
Participating Actor Instances	Alice: User
Flow of Events	1. Alice signs in the UThere system successfully. 2. She presses the "Contact Us " button on the home page and is directed to the contact form. 3. Alice fills the contact form and submits it. 4. Alice sign outs. 5. Authorities will respond to her inquiry as soon as possible within the

	next 4 business days by sending mail to her registered email address.

Scenario Name	changePersonalInformation
Participating Actor Instances	Bob: User
Flow of Events	1. Bob signs in the UThere system successfully. 2. Bob presses the “Profile” button on the home page and is directed to his profile page. 3. Bob chooses “Profile Information Tab” and by clicking the pencil icon next to the fields email, password, name, surname parts, edits his profile. 4. He presses the “Save” button to save changes. 5. Bob signs out.

3.5.2 Use Case Model

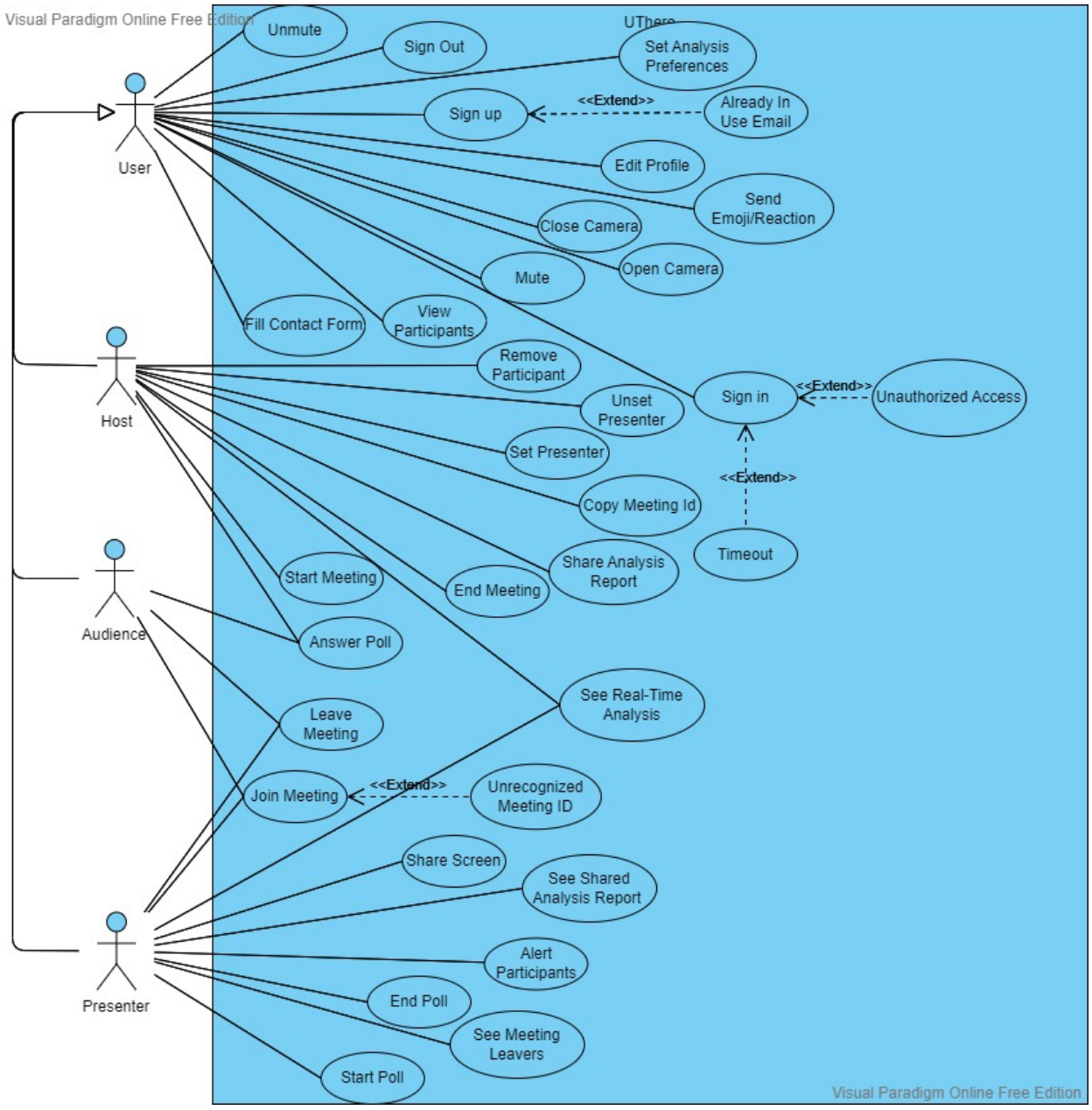


Figure 1: Use Case Model

3.5.3.2.1 Use Case Textual Representations

3.5.3.2.1.1 Sign Up Use Case

Use Case: Sign Up
Primary Actor(s): User
Stakeholders and Interests:

- Actor wants to register to the system.
- System checks the entered information and registers the actor to the system.

Entry Condition:

- The written email in the sign up process must not be already in use.

Exit Condition:

- The actor is directed to the “Sign In” page.
- User receives a message about the success of the operation.

Success Scenario Event Flow:

1. Actor fills the sign up form by entering his/her name, surname, email, password and verification of the entered password to register to the system.
2. UThere checks whether the entered email is already in use or valid. Then, it creates an account for the user. .

3.5.3.2.1.2 Sign In Use Case

Use Case: Sign In

Primary Actor(s): User

Stakeholders and Interests:

- Actor wants to sign in to the system.
- System checks the entered information and lets the actor into the application.

Entry Condition:

- There must exist an account with entered email and password.
- The user should not be inactive while using the UThere for a long time to be kept signed in.

Exit Condition:

- The actor is directed to the “Home” page.

Success Scenario Event Flow:

1. Actor enters email and password to enter the system.
2. UThere checks whether the entered email and password is valid and true. Then, UThere allows users to enter the system.

3.5.3.2.1.3 Start Meeting Use Case

Use Case: Start Meeting

Primary Actor(s): Host

Stakeholders and Interests:

- Actor wants to start a meeting.
- System creates a meeting.

Entry Condition:

- The Host is signed in to UThere.

Exit Condition:

- The actor is directed to the “Meeting” page.

Success Scenario Event Flow:

1. Actor presses the “New Meeting” button from his/her home page.
2. UThere creates a meeting with an unique ID and makes the user who starts the meeting the Host. .

3.5.3.2.1.4 End Meeting Use Case

Use Case: End Meeting

Primary Actor(s): Host

Stakeholders and Interests:

- Actor wants to end the meeting.

- System ends the meeting.

Entry Condition:

- The Host is signed in to UThere and is in the meeting.

Exit Condition:

- The actor is directed to the “Home” page.

Success Scenario Event Flow:

1. Actor presses the “End Meeting” button at the bottom of the “Meeting” Page.
2. UThere ends the meeting for all of the participants.

3.5.3.2.1.5 Copy Meeting Id Use Case

Use Case: Copy Meeting Id

Primary Actor(s): Host

Stakeholders and Interests:

- Actor wants to copy the meeting Id to share with the desired participants.

Entry Condition:

- The Host is in the meeting.

Exit Condition:

- There is no exit condition.

Success Scenario Event Flow:

1. Actor presses the “Copy Meeting Id” button at the bottom of the “Meeting” Page.
2. UThere system gives the unique meeting Id to the Host.

3.5.3.2.1.6 Join Meeting Use Case

Use Case: Join Meeting

Primary Actor(s): Audience, Presenter

Stakeholders and Interests:

- Actors want to join the meeting.

Entry Condition:

- There should be a meeting with entered Id.
- The actor should be signed in.

Exit Condition:

- The actor is directed to the “Meeting” Page.

Success Scenario Event Flow:

1. Actor presses the “Join Meeting” button on the “Home” Page.
2. Actor enters the meeting Id which is shared by the host.
3. UThere checks the meeting Id to find out whether there is a meeting with the entered Id or not. It enables the actor to enter the meeting.

3.5.3.2.1.7 Leave Meeting Use Case

Use Case: Leave Meeting

Primary Actor(s): Audience, Presenter

Stakeholders and Interests:

- Actor wants to leave the meeting.

Entry Condition:

- The actor should be in a meeting.

Exit Condition:

- The actor is directed to the “Home” Page.

Success Scenario Event Flow:

1. Actor presses the “Leave Meeting” button at the bottom of the “Meeting” Page.
2. Actor will be removed from the participants. If the presenter leaves the meeting, UThere will set the host as the presenter by default. .

3.5.3.2.1.8 Share Screen Use Case

Use Case: Share Screen
Primary Actor(s): Presenter
Stakeholders and Interests:

- Actor wants to share the screen.

Entry Condition:

- The actor should be in a meeting.

Exit Condition:

- The actor’s screen will be the main view screen for all participants.

Success Scenario Event Flow:

1. Actor presses the “Share Screen” button at the bottom of the “Meeting” Page.
2. UThere makes the actor's screen the main view screen of all participants.

3.5.3.2.1.9 Start Poll Use Case

Use Case: Start Poll
Primary Actor(s): Presenter
Stakeholders and Interests:

- Actor wants to start a poll to increase the attention level of the participants.

Entry Condition:

- The actor should be in a meeting.

Exit Condition:

- There is no exit condition.

Success Scenario Event Flow:

1. Actor presses the “Start Poll” button at the bottom of the “Meeting” Page.
2. UThere creates a poll and makes it visible on every participant's screen.

3.5.3.2.1.10 Answer Poll Use Case

Use Case: Answer Poll
Primary Actor(s): Audience, Host
Stakeholders and Interests:

- Actor wants to answer the poll which is created by the presenter.

Entry Condition:

- The actor should be in a meeting and there should be an already created poll.

Exit Condition:

- After the poll is answered, the meeting screen will be the main screen.

Success Scenario Event Flow:

1. Actor answers the poll questions that are visible in his “Meeting” Page as pop-up.
2. The answers of the poll will be shared and shown to the presenter.

3.5.3.2.1.11 Set Presenter Use Case

Use Case: Set Presenter
Primary Actor(s): Host
Stakeholders and Interests:

- Actor wants to set the presenter role.

Entry Condition:

- The actor should be in a meeting.

Exit Condition:

- There is no exit condition.

Success Scenario Event Flow:

1. Actor sets the presenter from the lists of the participants.
2. UThere enables “Poll” and “Share Screen” buttons at the bottom of the setted presenter’s meeting page. According to setted presenter’s analysis preferences, the attention scale is shown to him/her.

3.5.3.2.1.12 Unset Presenter Use Case

Use Case: Unset Presenter

Primary Actor(s): Host

Stakeholders and Interests:

- Actor wants to unset the presenter role.

Entry Condition:

- The actor should be in a meeting and there should be a presenter.

Exit Condition:

- There is no exit condition.

Success Scenario Event Flow:

1. Actor unsets the presenter.
2. UThere disables “Poll” and “Share Screen” buttons at the bottom of the setted presenter’s meeting page. The attention scale shown to him/her disappears.

3.5.3.2.1.13 Fill Contact Form Use Case

Use Case: Fill Contact Form

Primary Actor(s): User

Stakeholders and Interests:

- The actor wants to get help or inform the authority about an error.

Entry Condition:

- The actor should be signed in to UThere.

Exit Condition:

- The actor is directed back to the home page after filling and submitting the form.

Success Scenario Event Flow:

1. The actor should press the “Contact Us” button on the home page.
2. The actor fills in the form and submits it.
3. UThere saves the form submission and notify the authorities through email.

3.5.3.2.1.14 Open Camera Use Case

Use Case: Open Camera

Primary Actor(s): User

Stakeholders and Interests:

- The actor wants to turn on the camera.

Entry Condition:

- The actor should be signed in to UThere.
- The actor’s camera should be turned off.

- The actor should have already attended a meeting and allowed the system to share his/her camera.

Exit Condition:

- The actor's face will be visible to all participants.

Success Scenario Event Flow:

1. The actor presses the "Turn On" button at the bottom of the meeting screen.
2. UThere makes the actor's face visible to all participants, allowing the system to analyze the actor's attention rate.

3.5.3.2.1.15 Close Camera Use Case

Use Case: Close Camera
Primary Actor(s): User
Stakeholders and Interests:

- The actor wants to turn off the camera.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.
- The actor's camera should be turned on.

Exit Condition:

- The actor's face becomes no more visible to other participants.

Success Scenario Event Flow:

1. The actor presses the "Turn Off" button at the bottom of the meeting screen.
2. UThere makes the actor's face no more visible to other participants so the attention rate of the actor cannot be analyzed any longer.

3.5.3.2.1.16 Sign Out Use Case

Use Case: Sign Out
Primary Actor(s): User
Stakeholders and Interests:

- The actor wants to sign out of UThere.

Entry Condition:

- The actor should be signed in to UThere.

Exit Condition:

- The actor is directed back to the login page.

Success Scenario Event Flow:

1. The actor presses the "Sign Out" button at the top right of the pages.
2. The actor is directed back to the login page and needs to enter authentication information to create or attend a meeting again.

3.5.3.2.1.17 Set Analysis Preferences Use Case

Use Case: Set Analysis Preferences
Primary Actor(s): User
Stakeholders and Interests:

- The actor wants to set the preferences of attention rate analysis such as setting an attention rate limit desired to be achieved or hiding the attention rate scale on the screen.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should be on the profile page.

Exit Condition:

- There is no exit condition.

Success Scenario Event Flow:

1. The actor presses the “Profile” button on the home page.
2. The actor sets the preferences and saves it.
3. The page is refreshed and the changes on preferences are displayed on the profile page.

3.5.3.2.1.18 Mute Use Case

Use Case: Mute

Primary Actor(s): User

Stakeholders and Interests:

- The actor wants to mute himself/herself.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.
- The actor should be unmuted.

Exit Condition:

- The actor’s voice becomes no more audible by other participants.

Success Scenario Event Flow:

1. The actor presses the “Mute” button.
2. The actor’s voice becomes no more audible to other participants.

3.5.3.2.1.19 Unmute Use Case

Use Case: Unmute

Primary Actor(s): User

Stakeholders and Interests:

- The actor wants to unmute himself/herself.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.
- The actor should be muted.

Exit Condition:

- The actor’s voice becomes audible by other participants.

Success Scenario Event Flow:

1. The actor presses the “Unmute” button.
2. The actor’s voice becomes audible to other participants.

3.5.3.2.1.20 Edit Profile Use Case

Use Case: Edit Profile

Primary Actor(s): User

Stakeholders and Interests:

- The actor wants to edit his/her profile such as changing the name displayed in the meetings, email, and password.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should be on the profile page.

Exit Condition:

- The profile information is displayed on the profile page.

Success Scenario Event Flow:

1. The actor presses the “Profile” button on the home page.
2. The actor sets the corresponding information and saves it.
3. The page is refreshed and the profile information is displayed on the profile page by the UThere system.

3.5.3.2.1.21 View Participants Use Case

Use Case: View Participants
Primary Actor(s): User
Stakeholders and Interests:

- The actor wants to see the whole list of participants of a meeting.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.

Exit Condition:

- A pop-up displaying all the participants appears on the screen.

Success Scenario Event Flow:

1. The actor presses the “View Participants” button in a meeting screen.
2. All participants including the actor are displayed in a list popping up on the screen.

3.5.3.2.1.22 Send Emoji/Reaction Use Case

Use Case: Send Emoji/Reaction
Primary Actor(s): User
Stakeholders and Interests:

- The actor wants to send an emoji/reaction to participate in the presentation.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.

Exit Condition:

- The emoji/reaction is displayed on the actor’s profile icon on the meeting screen.

Success Scenario Event Flow:

1. The actor selects an emoji/reaction to send.
2. The emoji/reaction sent is displayed on the actor’s profile icon next to his/her video.
3. A notification is sent to the presenter about which user sent an emoji/reaction.

3.5.3.2.1.23 See Analysis Report Use Case

Use Case: See Analysis Report
Primary Actor(s): Host
Stakeholders and Interests:

- The actor wants to see the attention rate analysis report at the end of the presentation.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.
- The presentation should be over.

Exit Condition:

- The report in pdf format is provided to the actor and it is allowed to be downloaded.

Success Scenario Event Flow:

1. The actor finishes the presentation and a report of attention level analysis of the presentation is generated.
2. The actor can view and download the report from the profile page.

3.5.3.2.1.24 See Real-Time Analysis Use Case

Use Case: See Real-Time Analysis
Primary Actor(s): Presenter, Host
Stakeholders and Interests:

- The actor wants to see the real-time analysis outcomes of the presentation.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.
- The actor's preference for hiding the attention rating scale on the screen should be off.

Exit Condition:

- An attention rating scale is displayed on the screen.

Success Scenario Event Flow:

1. During the presentation, an attention rating scale showing the average attention rate of the participants is displayed on the screen.
2. The attention rating scale is updated whenever the rate changes.

3.5.3.2.1.25 See Meeting Leavers Use Case

Use Case: See Meeting Leavers
Primary Actor(s): Presenter
Stakeholders and Interests:

- The actor wants to be informed about the participants that leave the meeting.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.

Exit Condition:

- A notification pop-up is displayed on the actor's screen.

Success Scenario Event Flow:

1. While the actor is presenting, some participants leave the meeting.
2. The names of the participants that leave the meeting are displayed as a notification pop-up on the actor's screen.

3.5.3.2.1.26 Share Analysis Report Use Case

Use Case: Share Analysis Report
Primary Actor(s): Host
Stakeholders and Interests:

- The actor wants to share the analysis report with the other participants.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.
- The presentation should be over.

Exit Condition:

- The actor will be directed to the “Home Page”.

Success Scenario Event Flow:

1. At the end of the meeting, the actor will choose people whom he wants to share the analysis report with.

2. UThere makes these reports visible in the selected participants’ profile page.

3.5.3.2.1.27 See Shared Analysis Report Use Case

Use Case: See Shared Analysis Report

Primary Actor(s): Presenter

Stakeholders and Interests:

- The actor wants to see the analysis report which is shared with him.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should have already attended a meeting.
- The presentation should be over.
- The host of the meeting should share the report with him.

Exit Condition:

- The report in pdf format is provided to the actor and it is allowed to be downloaded

Success Scenario Event Flow:

1. The actor finishes the presentation and a report of attention level analysis of the presentation is generated.

2. The actor can view and download the report from the profile page.

3.5.3.2.1.28 Alert Participants Use Case

Use Case: Alert Participants

Primary Actor(s): Presenter

Stakeholders and Interests:

- The actor wants to alert participants.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should be in the meeting.
- There should be another participant other than the presenter.

Exit Condition:

- The warning is shown to the participants.

Success Scenario Event Flow:

1. The actor presses the “Participants” button at the bottom left of the meeting page.

2. The actor presses the “Alert” button which is next to the participant’s name who is desired to be removed.

3.The system sends a warning message to this participant from the meeting.

3.5.3.2.1.29 Remove Participant Use Case

Use Case:Remove Participant

Primary Actor(s): Host

Stakeholders and Interests:

- The actor wants to remove a participant.

Entry Condition:

- The actor should be signed in to UThere.
- The actor should be in the meeting.
- There should be another participant other than the presenter.

Exit Condition:

- The selected participant will be removed from the meeting.

Success Scenario Event Flow:

1. The actor press “Participants” button at the bottom left of the meeting page.
2. The actor press “Remove” button which is next to the participant’s name who is desired to be removed.
3. The system removes this participant from the meeting.

3.5.3 Object and Class Model

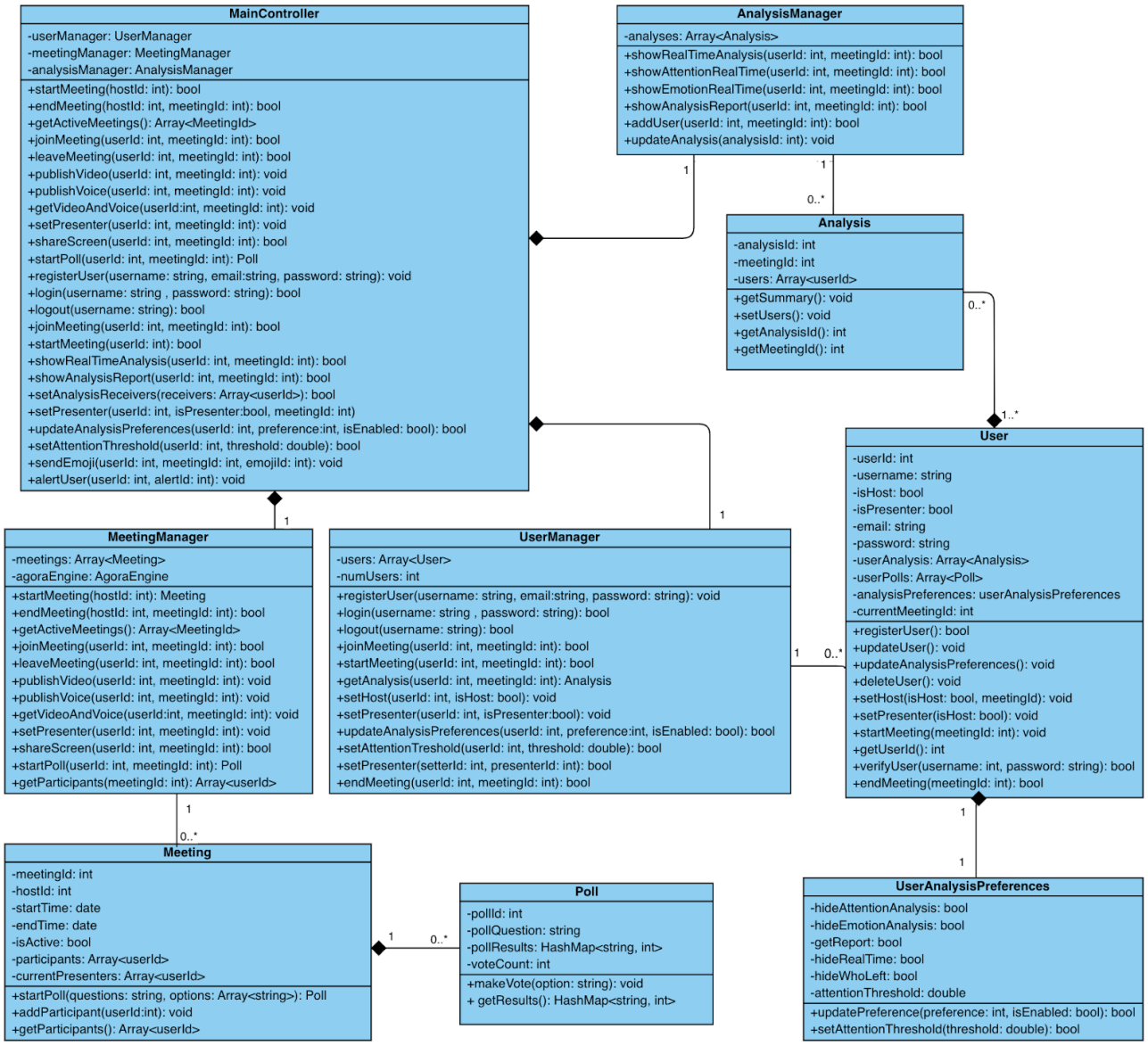


Figure 2: Object and Class Diagram

The object and class model is a representation of our design choices; however, in the implementation stage, we will use Django framework and some design decisions will be made by Django. It is important to notice that Object-Relational Mapping in Django will make all the database objects accessible from all the classes and the design might be a bit different than the one represented here [8][9].

In the object and class model, we have 9 classes. Four of them are the manager classes while the other five define the objects. “Main Controller” contains all of the managers which are “User Manager”, “Analysis Manager” and “Meeting Manager”. It combines the functionalities of these managers to make the application work. “User Manager” class contains the functionalities related to the user actions such as login, register, join meeting etc. It manages all of the users in the system. “Meeting Manager” class contains the functionalities related to the meetings such as publishing video, voice etc. This class manages all of the meetings in the system. “Analysis Manager” class contains the functionalities related to the analysis reports. It manages all of the analysis reports in the system. “Poll”, “User” and “Analysis” classes depict the objects in the application.

3.5.4 Dynamic Models

3.5.4.1 Sequence Diagram for Registration, Login and Logout Processes

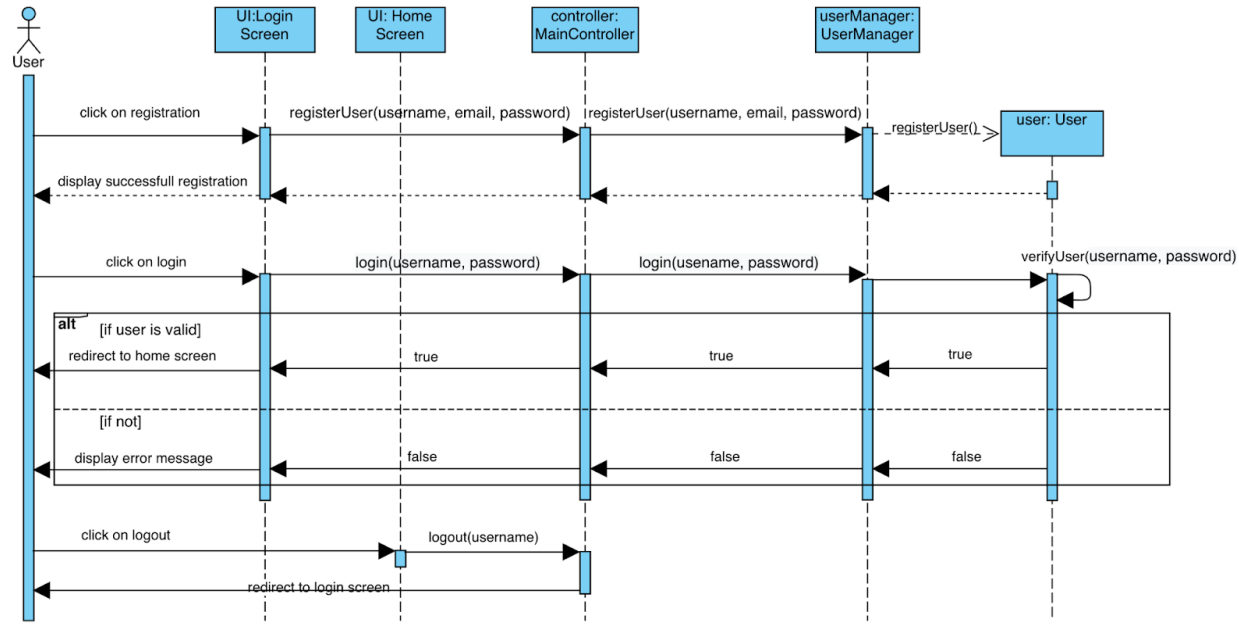


Figure 3: Sequence Diagram for Registration, Login and Logout Processes

This diagram shows the registration, login and logout processes. The registration process starts when the user clicks on sign up button on the login screen and types in his/her username, email and password. After that, main controller executes registerUser() function with these

parameters. In this function, user manager calls registerUser() function by passing same parameters. New user object is created with those parameters and added to the users array in the UserManager class. After those functions return, the user will be displayed a successful registration notification.

The login process starts when the user enters his/her email and password and clicks on the login button. Main controller executes login() function of the UserManager class by passing the username and the password of the user. UserManager class executes verifyUser() function of the User object which has the given username. User object executes verifyUser() function by passing the username and password. This checks if the entered username and the password is matching with the ones in the dataset. If the user is verified, the function returns true and mainController redirects to the home screen. If the user can not be verified, mainController redirects to the login screen by showing a notification about the unsuccessful login.

The logout process starts when the user clicks on logout button. Main controller executes logout function by getting the username. User is redirected to the login screen at the end.

3.5.4.2 Sequence Diagram for Start and Join Meeting Processes

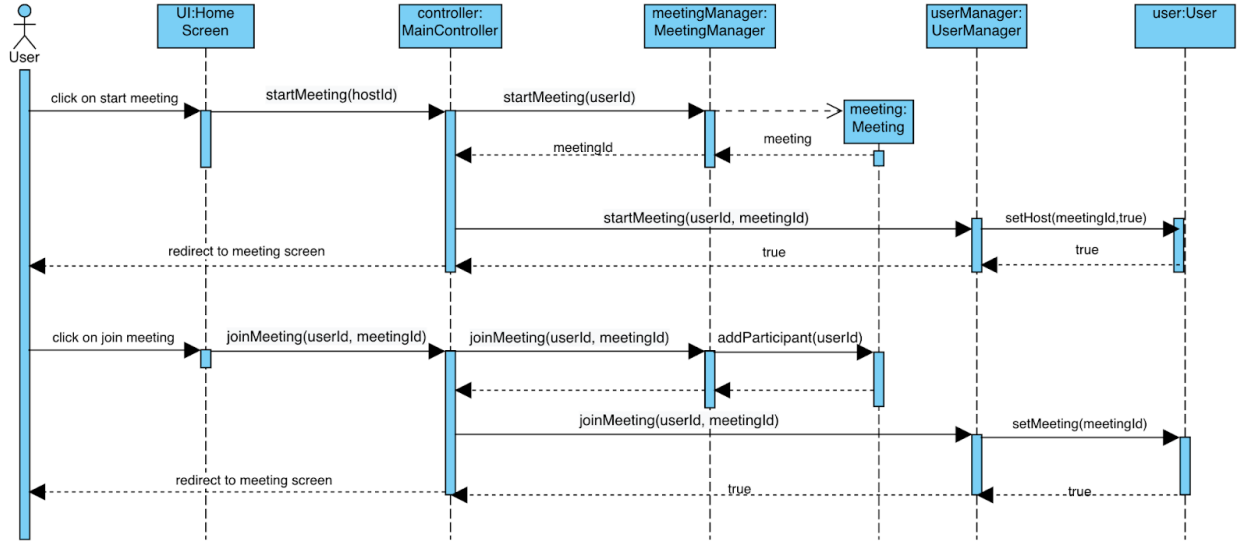


Figure 4: Sequence Diagram for Start and Join Meeting Processes

This diagram shows the start and join meeting processes. Start meeting process begins with the user to click on start meeting button. Main controller executes startMeeting() function by passing user's userId. In this function both meetingManager and userManager object are used to control meeting and user objects. First, meetingManager object constructs a new meeting object and returns the meetingId to the mainController. After that, userManager executes its startMeeting() function by passing the userId and meetingId. User object for a given userId executes setHost() function, which changes isHost attribute to true and sets currentMeetingId to the value passed by userManager. After that, user is redirected to the meeting screen by the main controller.

Join meeting process starts with user to enter meeting id and click on join meeting button in the home screen. Main controller executes joinMeeting() function by passing the meeting and user ids. First, meeting manager executes its joinMeeting() function, which adds the given user to the participants array of the meeting object. After, userManager executes its joinMeeting() function, which sets the currentMeetingId of the meeting object as the passed value.

3.5.4.3 Sequence Diagram for Set Presenter and See Analysis Processes

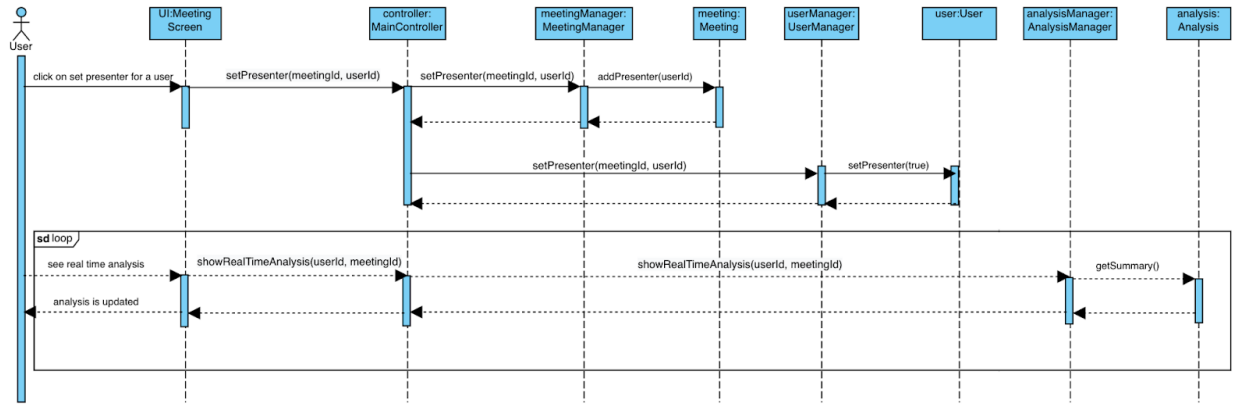


Figure 5: Sequence Diagram for Set Presenter and See Analysis Processes

This diagram demonstrates set presenter and see analysis processes. Set presenter process starts when the user clicks on the set presenter button. MainController executes setPresenter() function by passing the meeting and user ids. MeetingManager executes its setPresenter() function by executing the addPresenter() function of the meeting object. AddPresenter() function adds the userId to the presenters array. Then, userManager object executes its setPresenter() function by executing the setPresenter() function of the user object. IsPresenter attribute of the user object is set as true.

See Analysis process starts when a user is set as presenter. MainController executes showRealTimeAnalysis() function in a loop until user is unset as presenter. MainController executes this functionality by using the analysisManager object.

3.5.4.4 General Activity Diagram

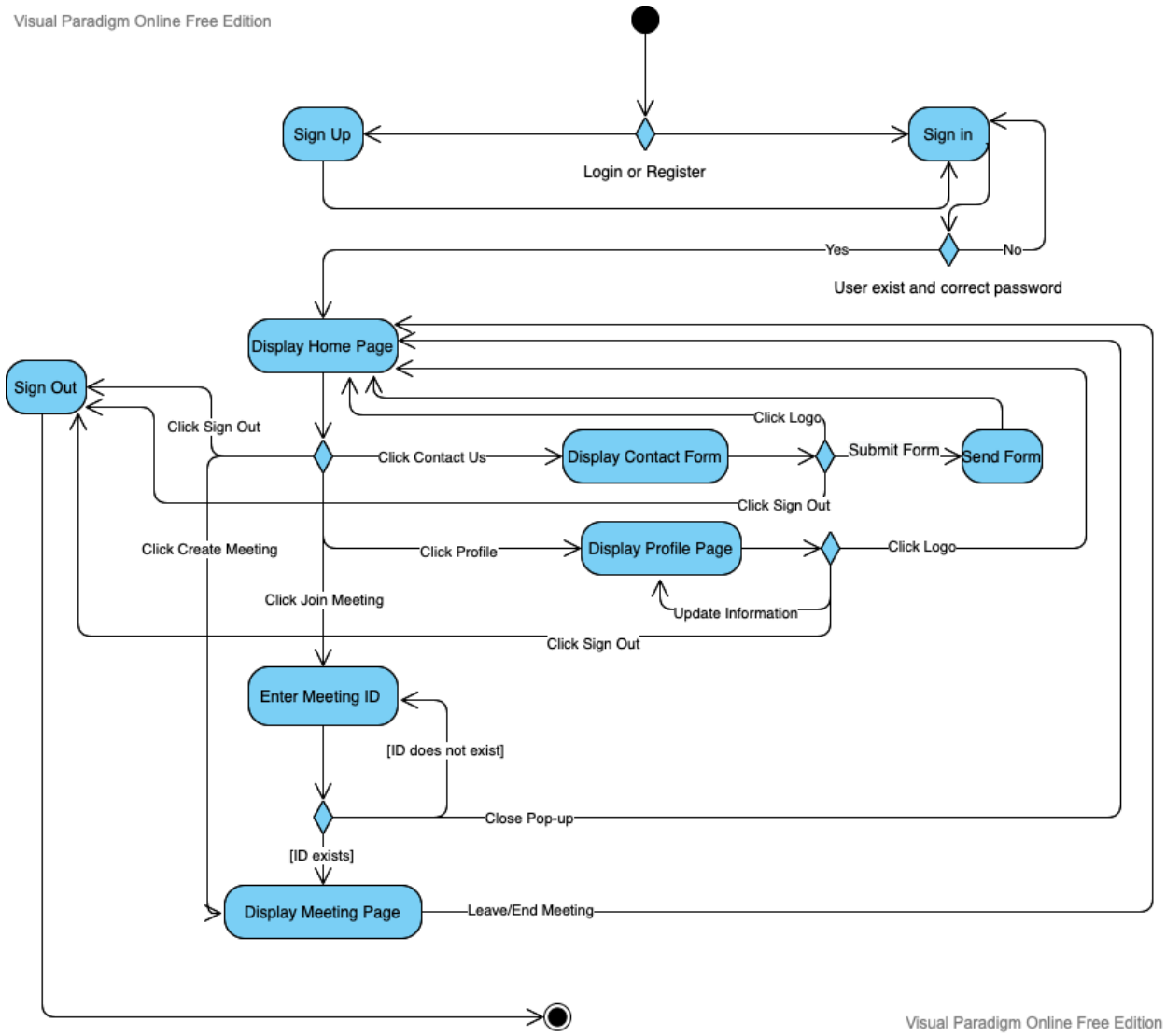


Figure 6: General Activity Diagram

The application begins with signing up or if a user has an account, the user can directly sign in the application. If the user enters the password correctly, the home page will be displayed. From the home page, users can click join meeting, create meeting, profile, contact us, and sign out sections.

When a user clicks create meeting, the user is defined as a host and the meeting page will be displayed directly. When the user ends the meeting, the home page will be displayed.

When a user clicks join meeting, a pop-up which asks for meeting ID will be displayed. If the user enters an ID that does not exist, the pop-up will not disappear until entering an existing ID or closing the pop-up. If the user enters an ID that exists, the meeting page will be displayed as an audience. When the user leaves the meeting or the host ends the meeting, the home page will be displayed.

By clicking profile, profile page will be displayed. Users can update their profiles on this page. After they update their profiles, the profile page will still be displayed. For displaying the home page, the logo should be clicked.

Lastly, for contacting admins, users can reach by clicking the contact us section and then contact form will be displayed. When users submit the contact form, the form will be sent to admins, and the home page will be displayed to users. They can also click on the logo to go to the home page if they do not want to fill the contact form.

3.5.4.5 Create Meeting Activity Diagram

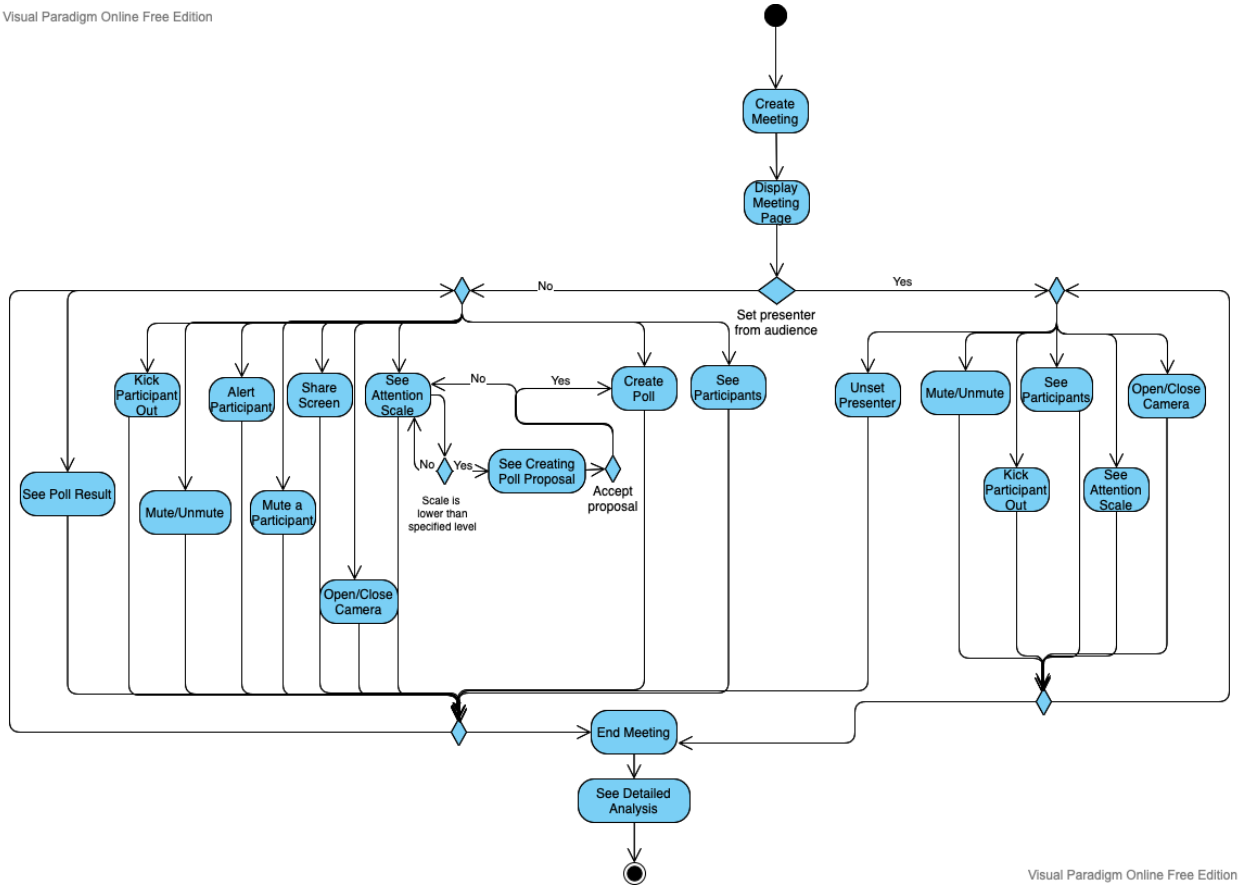


Figure 7: Creating Meeting Activity Diagram

This activity diagram demonstrates the meeting processes when a user creates a meeting. After creating a meeting, the meeting page will be displayed and the user is defined as a host of the meeting.

If the host sets a presenter from the audience, the host can mute or unmute herself/himself, see participants, open or close her/his camera, kick participants out of the meeting, and see attention scale.

If the host does not set a presenter from the audience, the host will remain as the presenter. In this case, the host can kick participants out of the meeting, mute or unmute

herself/himself, open or close her/his camera, mute participants, share screen, alert participants, create poll, see poll results, see participants, and see attention scale. If the attention scale is lower than the specified level in the profile, creating a poll proposal will be seen. Accepting the proposal will display creating a poll pop-up. Lastly, when the host ends the meeting, the detailed analysis report will be displayed.

3.5.4.6 Join Meeting Activity Diagram

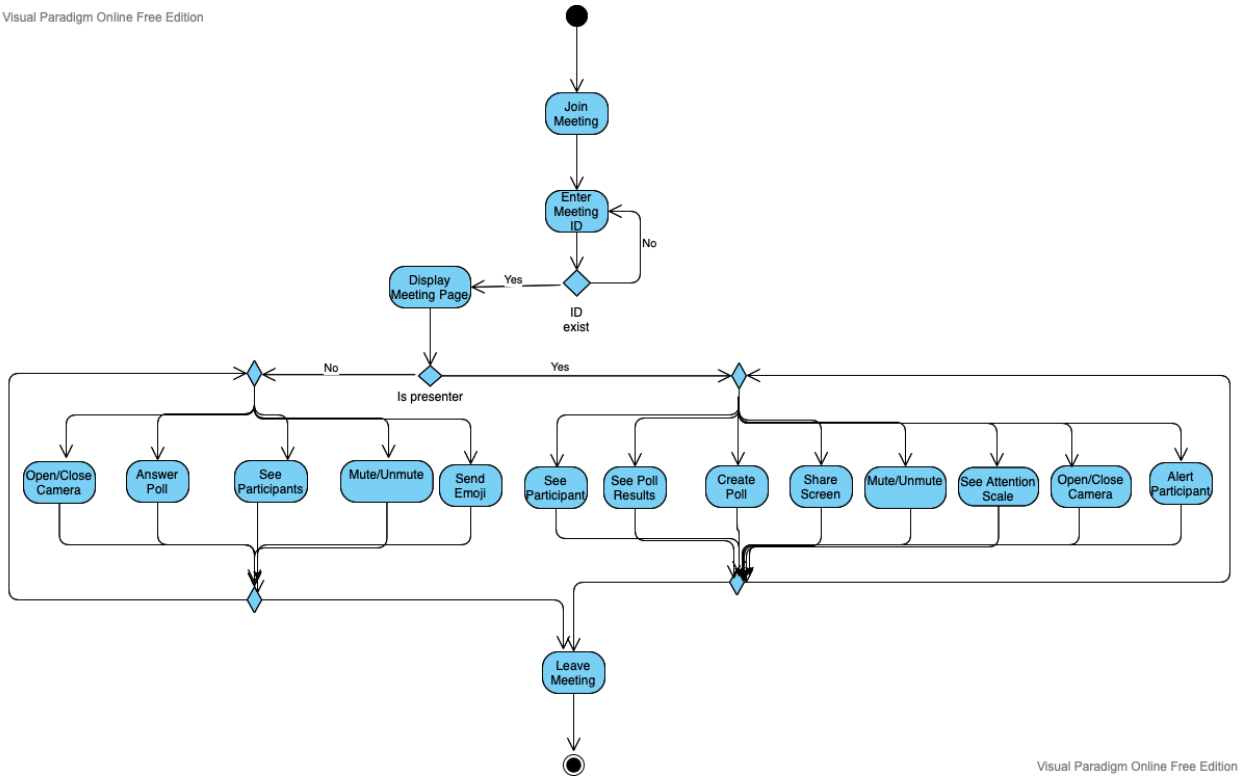


Figure 8: Join Meeting Activity Diagram

This activity diagram demonstrates the meeting processes when a user joins a meeting. After joining the meeting, the meeting ID will be asked. If the entered ID exists the meeting page will be displayed.

If the user is not a presenter, the user can mute or unmute herself/himself, open or close her/his camera, answer a poll, see participants, and send emoji. On the other hand, if the user is a presenter, the user can create a poll, see poll results, share screen, see attention scale, mute or unmute herself/himself, open or close her/his camera, see participants, and alert participants.

End point of this activity diagram is reached when the user leaves the meeting or the existing meeting is ended by the host.

3.5.5 User Interface - Navigational Paths and Screen Mock-ups

3.5.5.1 Sign Up Page

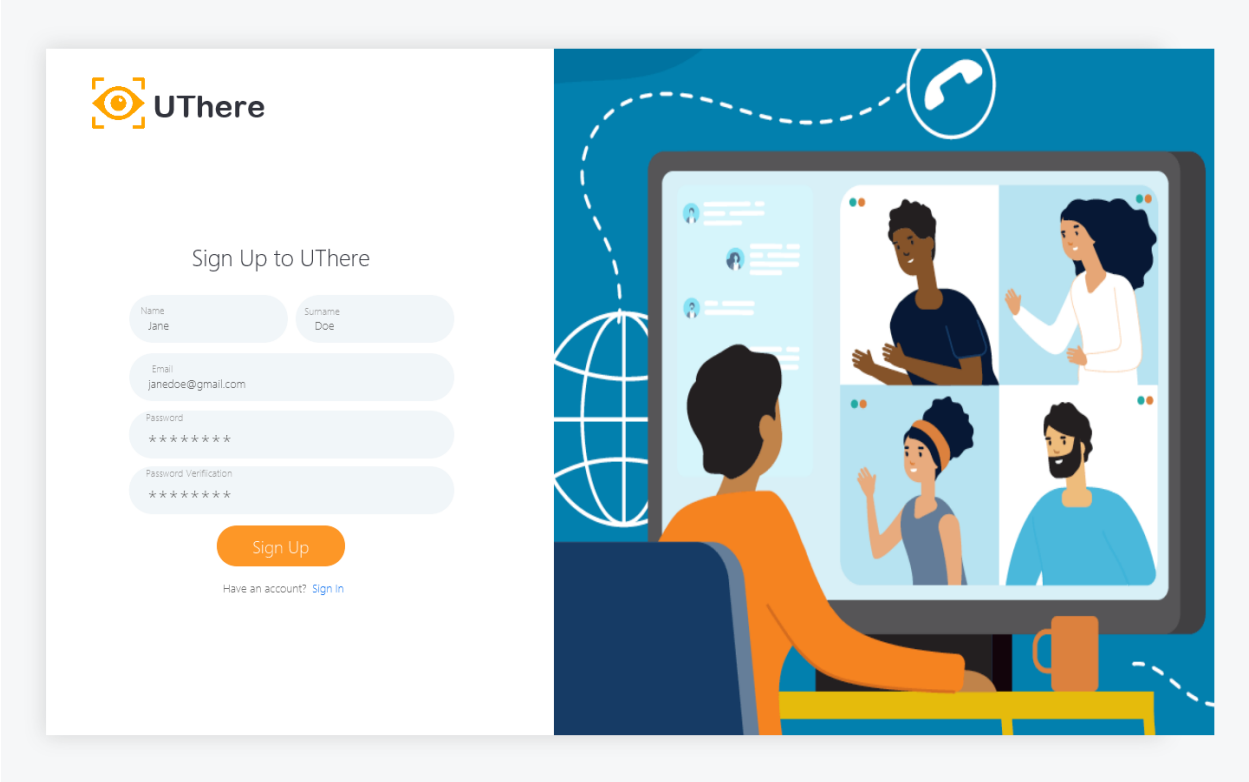


Figure 9: Sign Up Page

3.5.5.2 Sign In Page

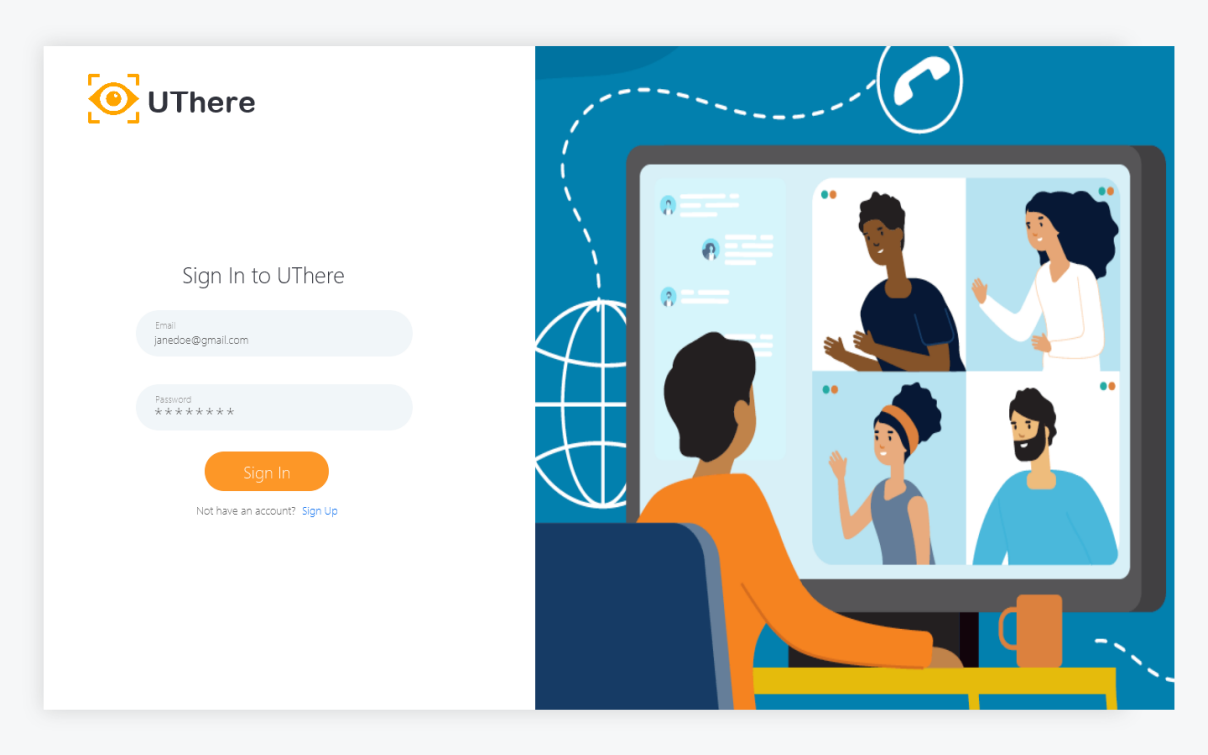


Figure 10: Sign In Page

3.5.5.3 Home Page

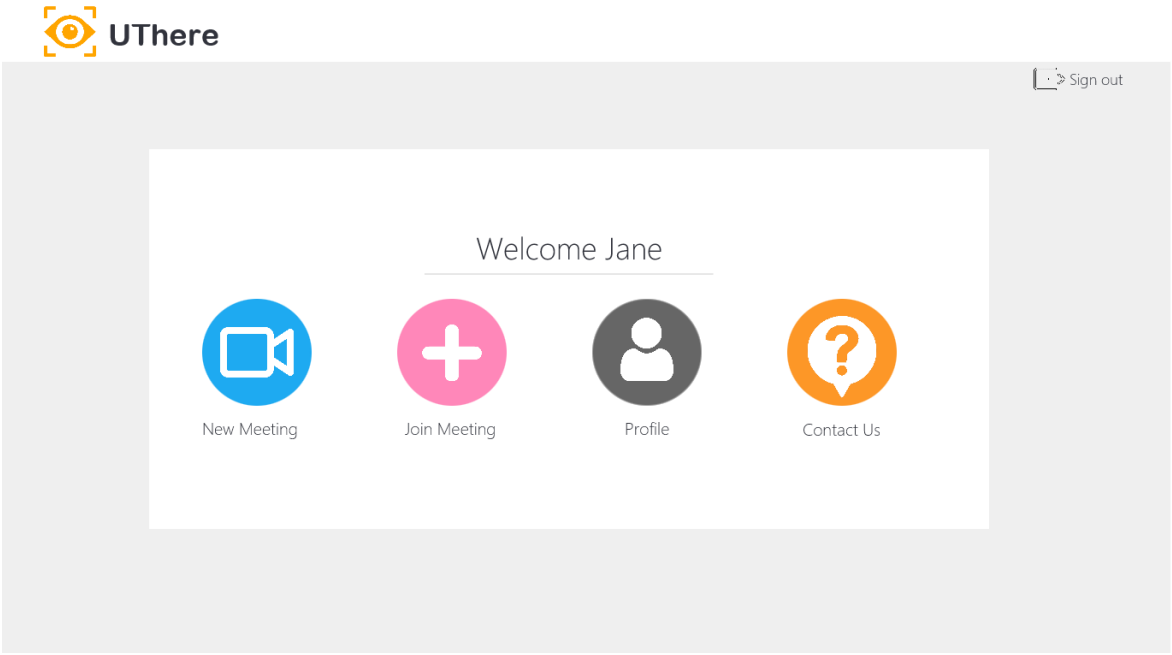


Figure 11: Home Page

3.5.5.4 Home Page Join Meeting Popup

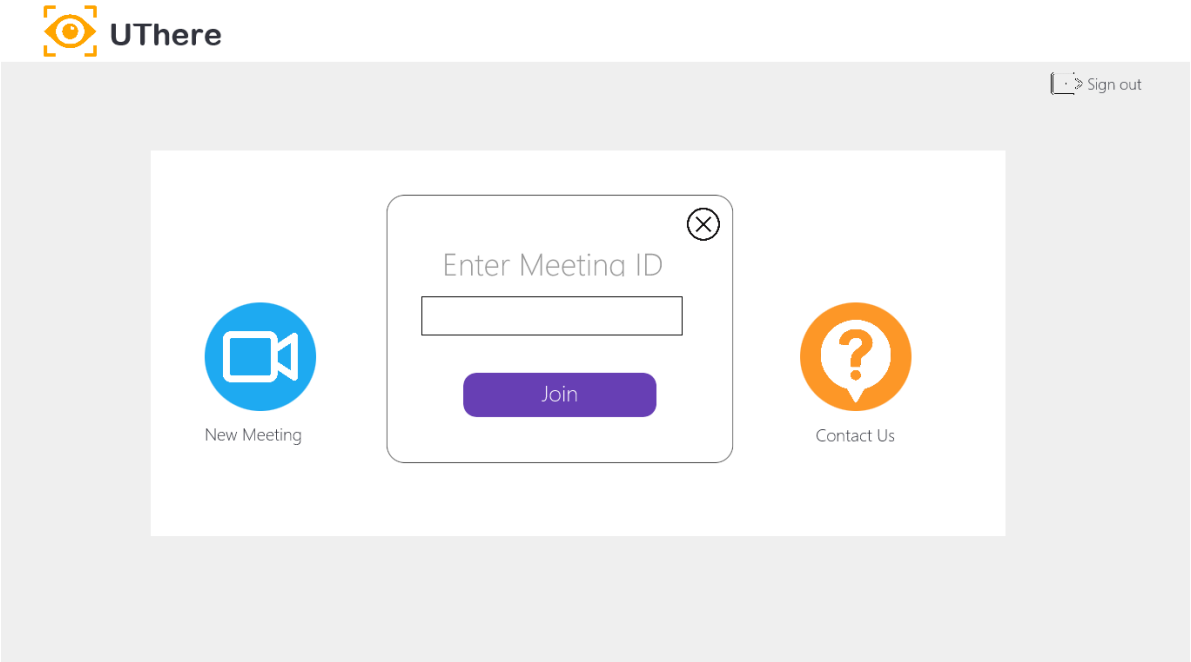


Figure 12: Home Page Join Meeting Popup

3.5.5.5 Meeting Page

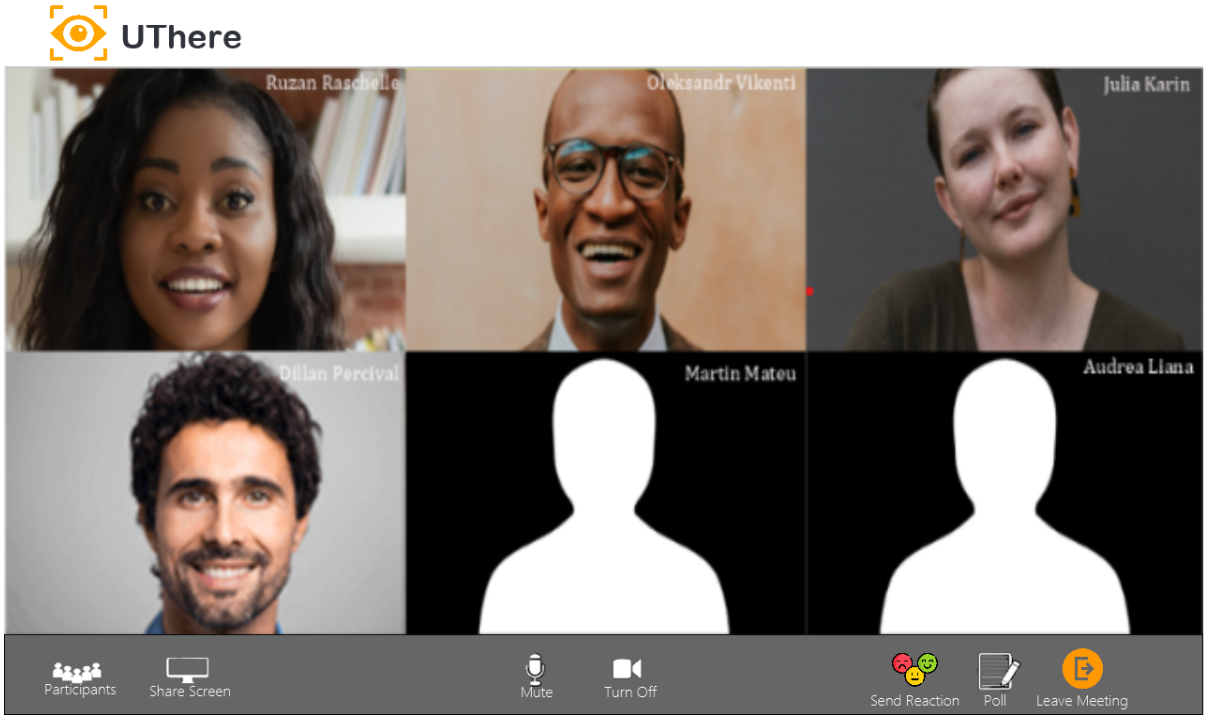
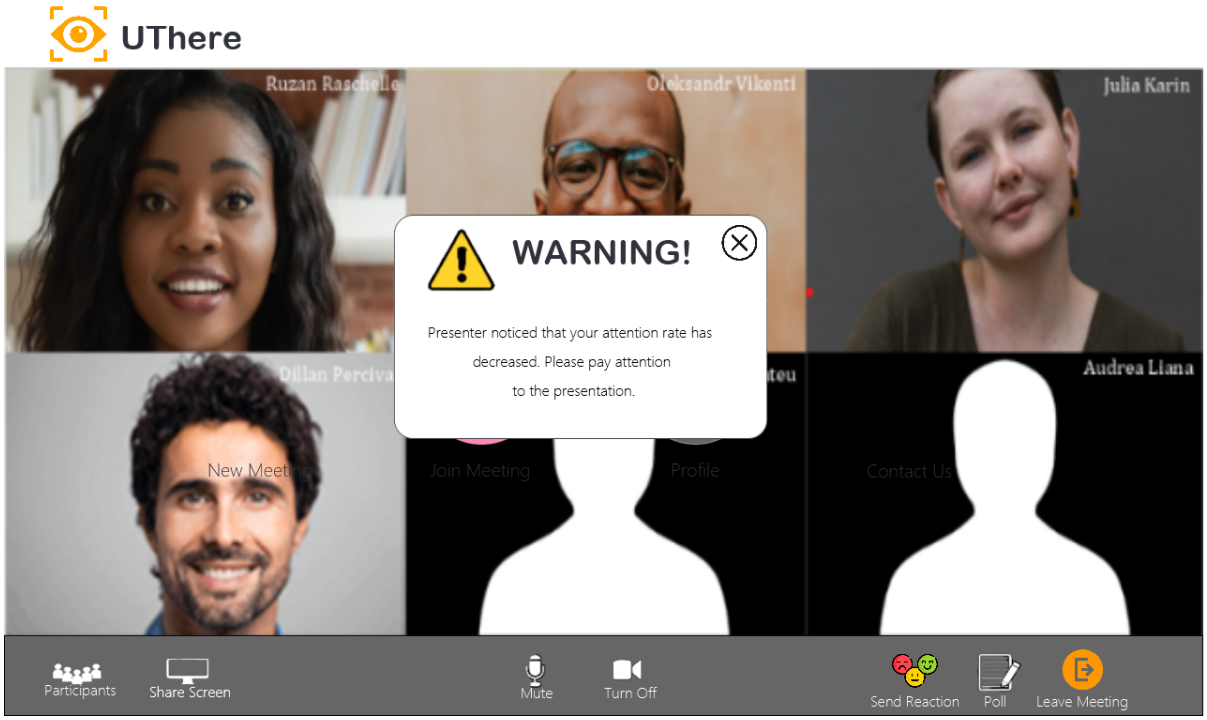
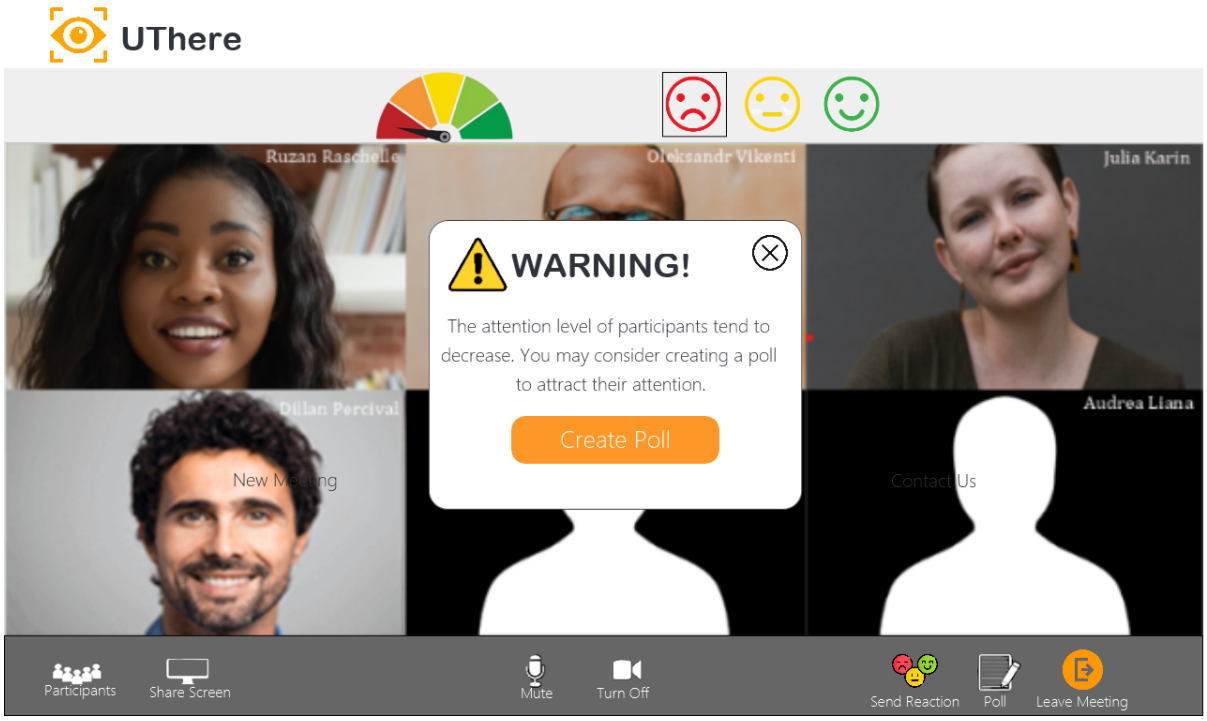


Figure 13: Meeting

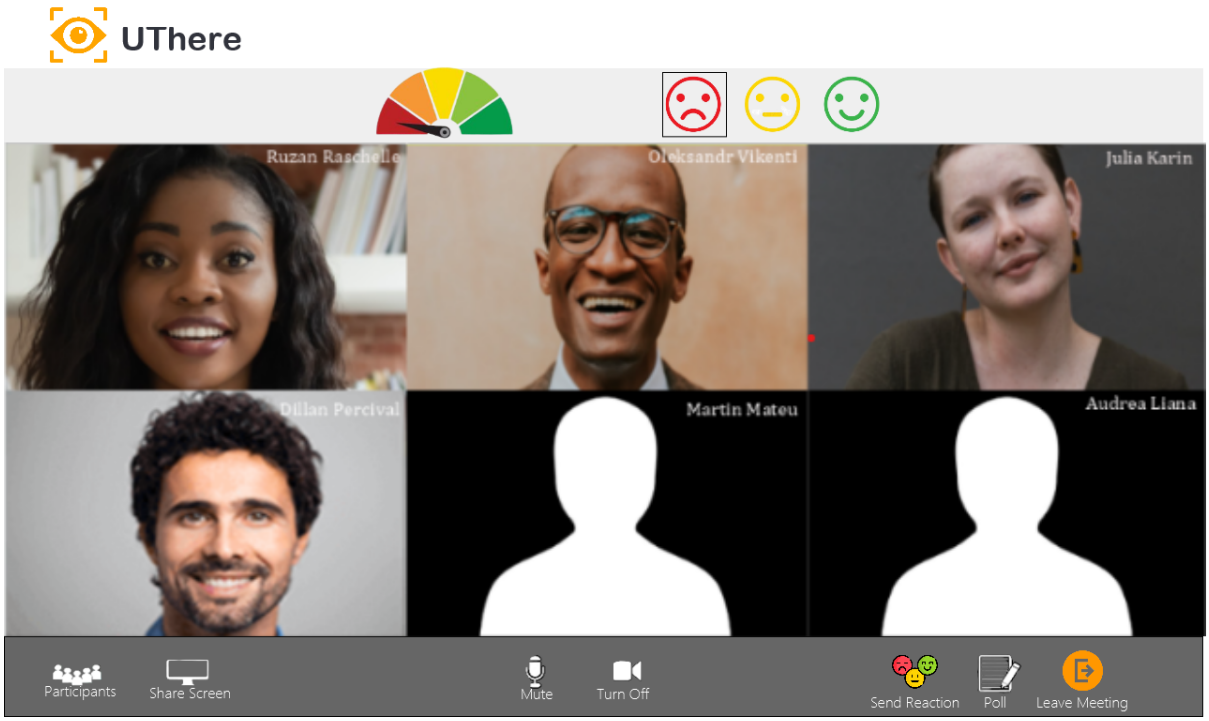
3.5.5.6 Meeting Page Alert the Participant



3.5.5.7 Meeting Page Alert the Presenter

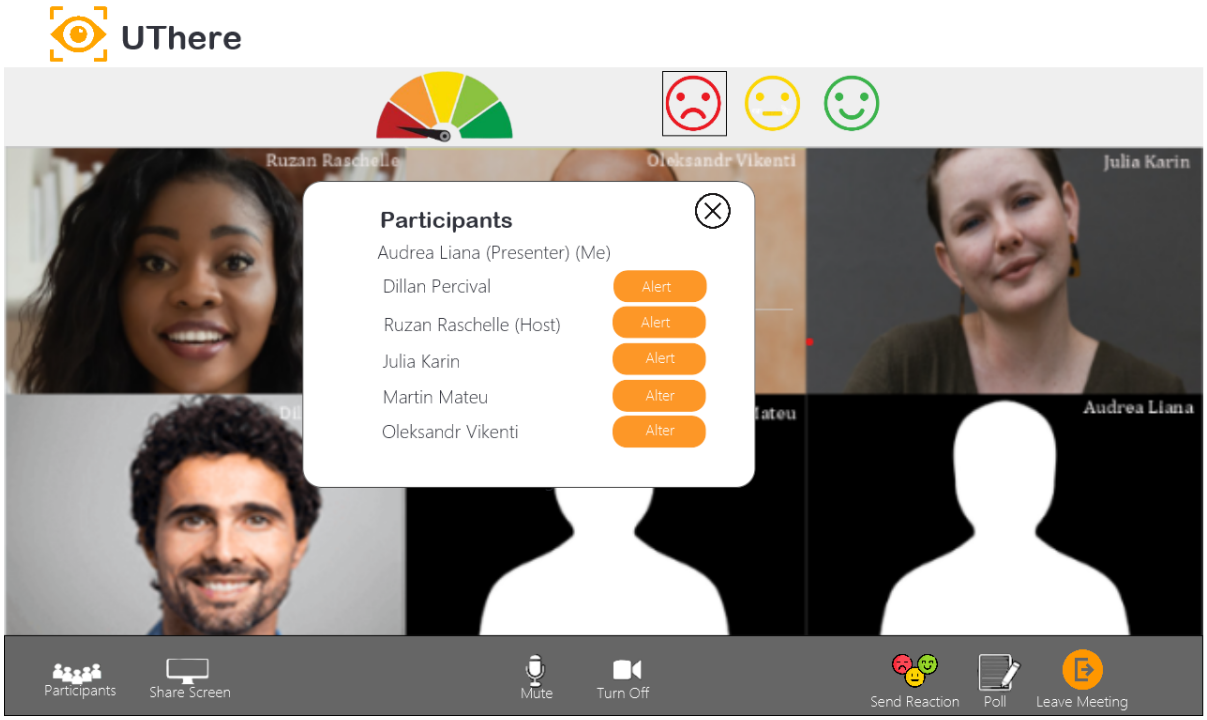


3.5.5.8 Meeting Page Real-Time Analysis

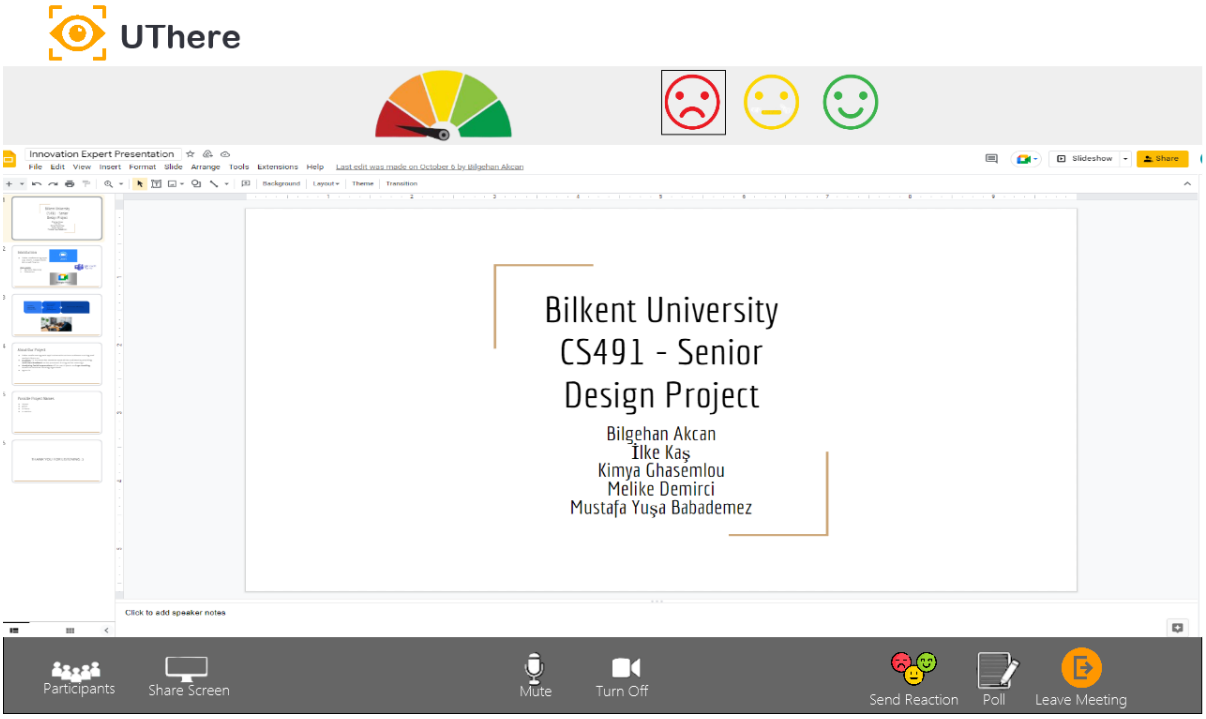


3.5.5.9 Meeting Page Host Set/Unset Presenter and Remove

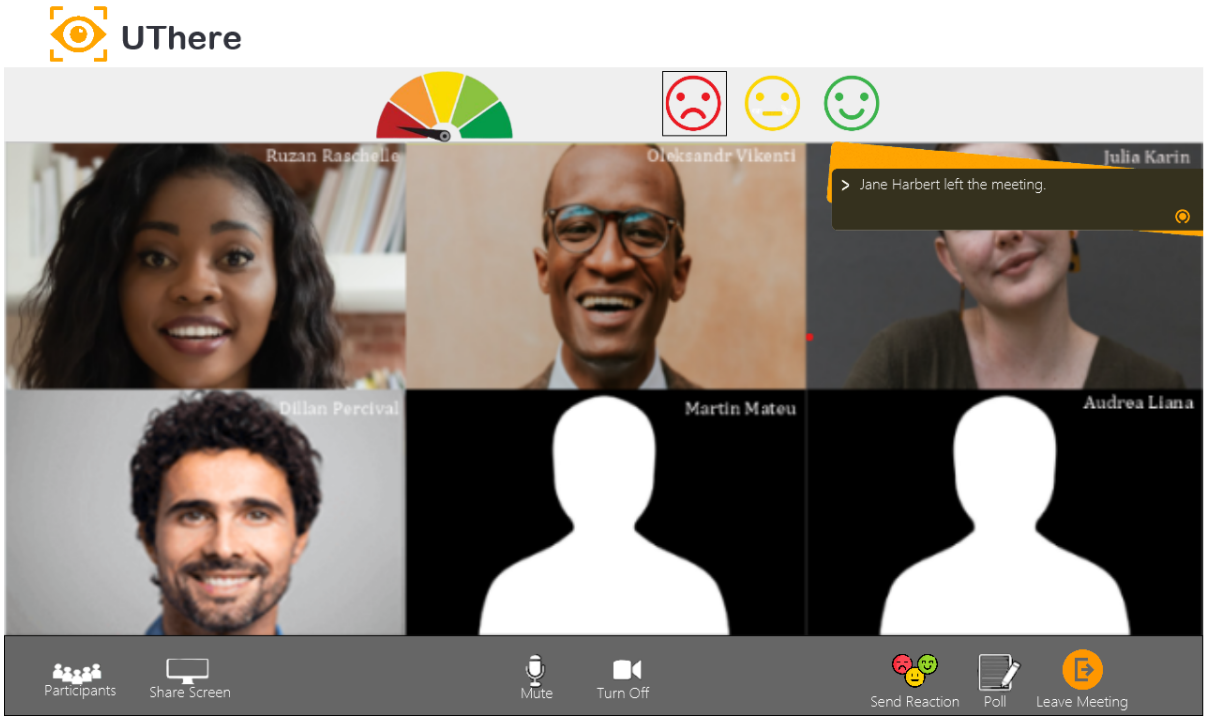
3.5.5.10 Meeting Page Presenter Alert



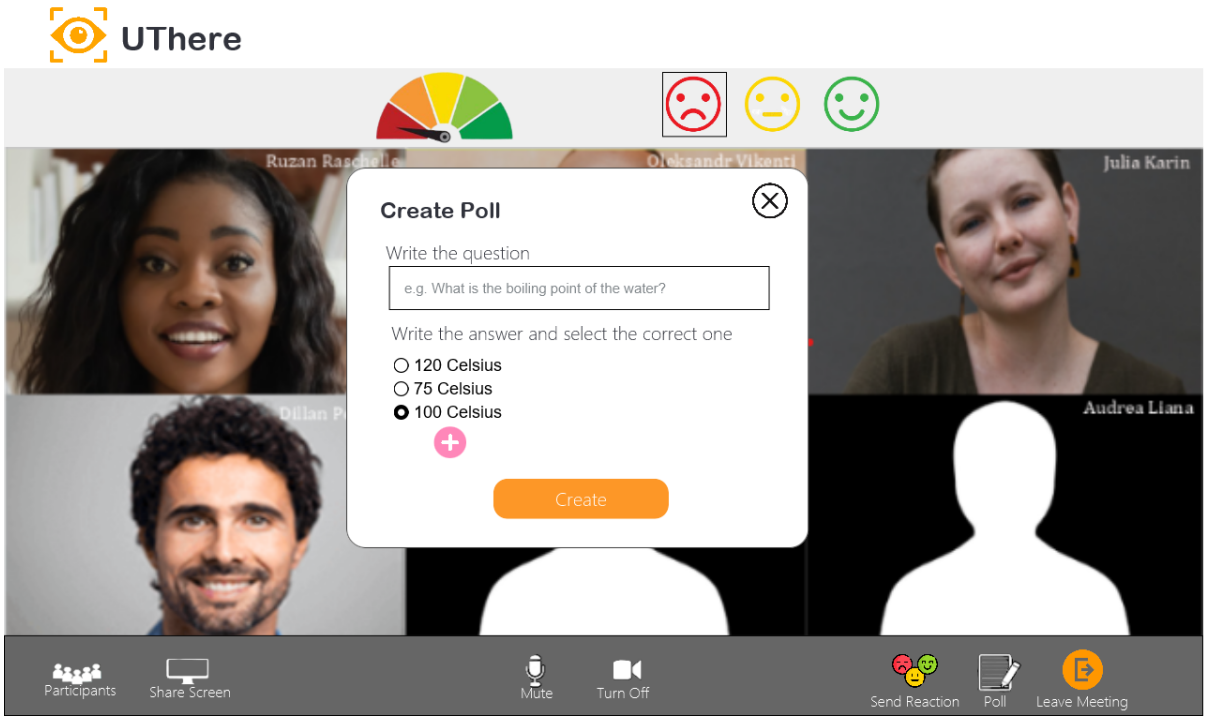
3.5.5.10 Meeting Page Presenter Share Screen



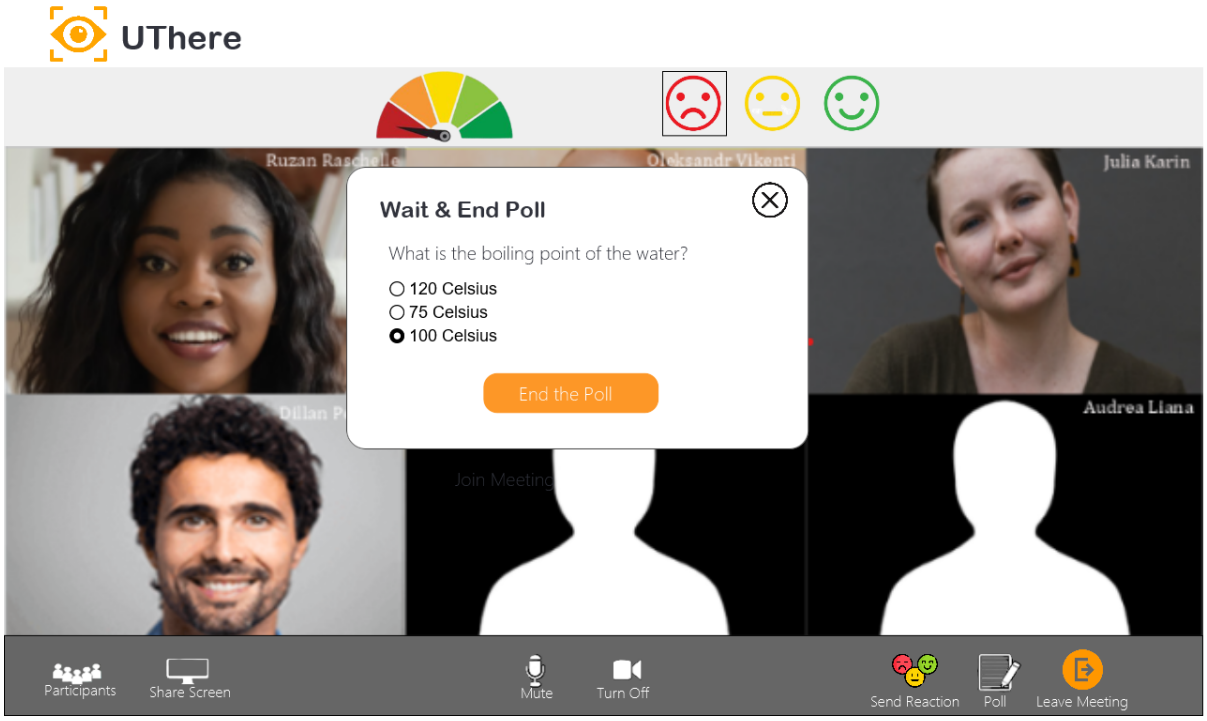
3.5.5.11 See Who Left The Meeting Pop up



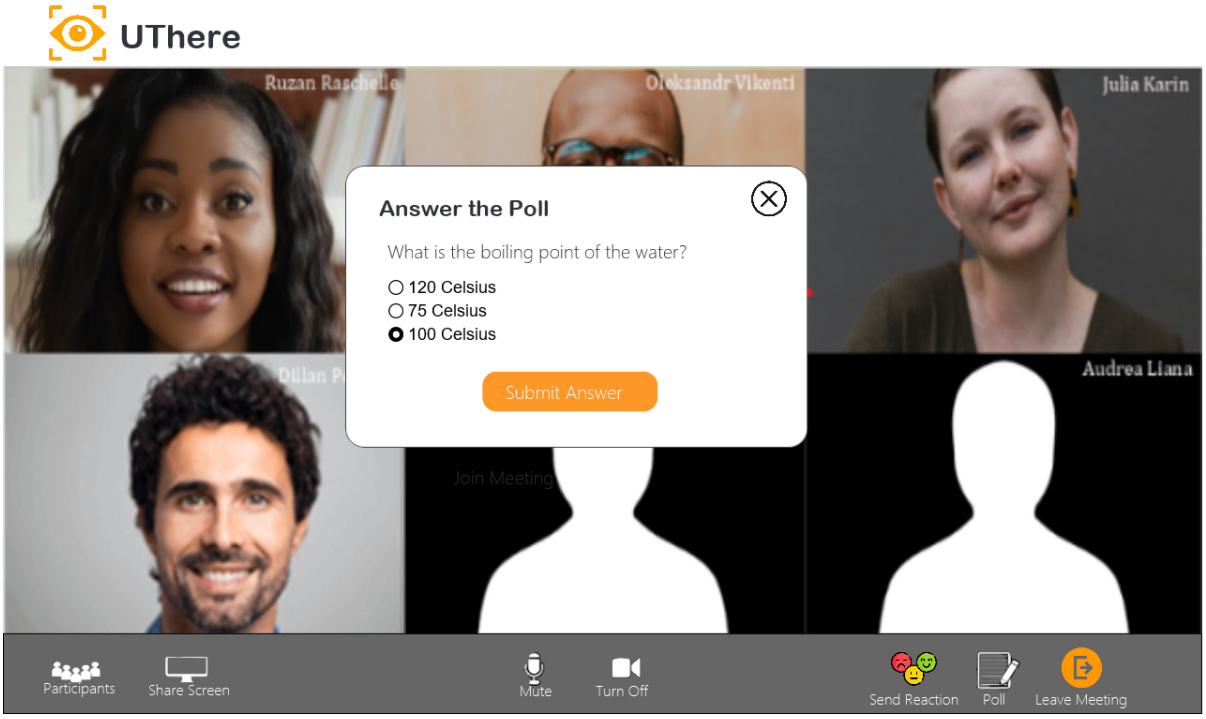
3.5.5.12 Create Poll for Presenter



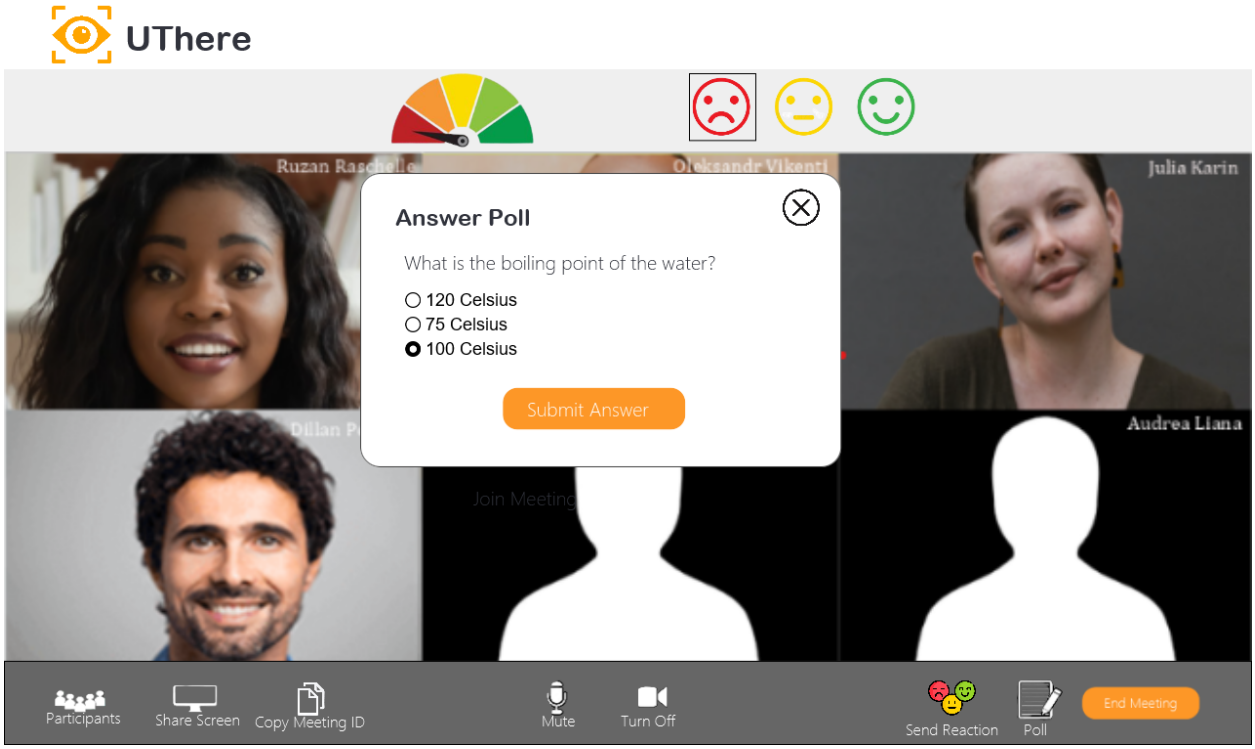
3.5.5.13 End Poll for Presenter



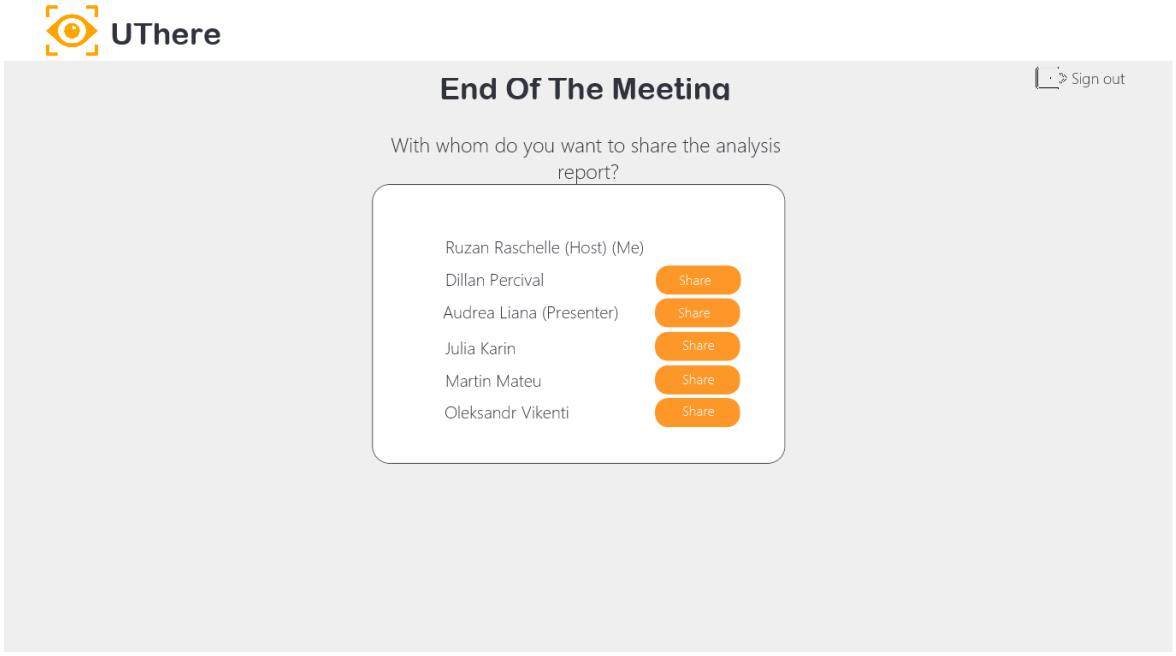
3.5.5.14 Answer Poll Audience



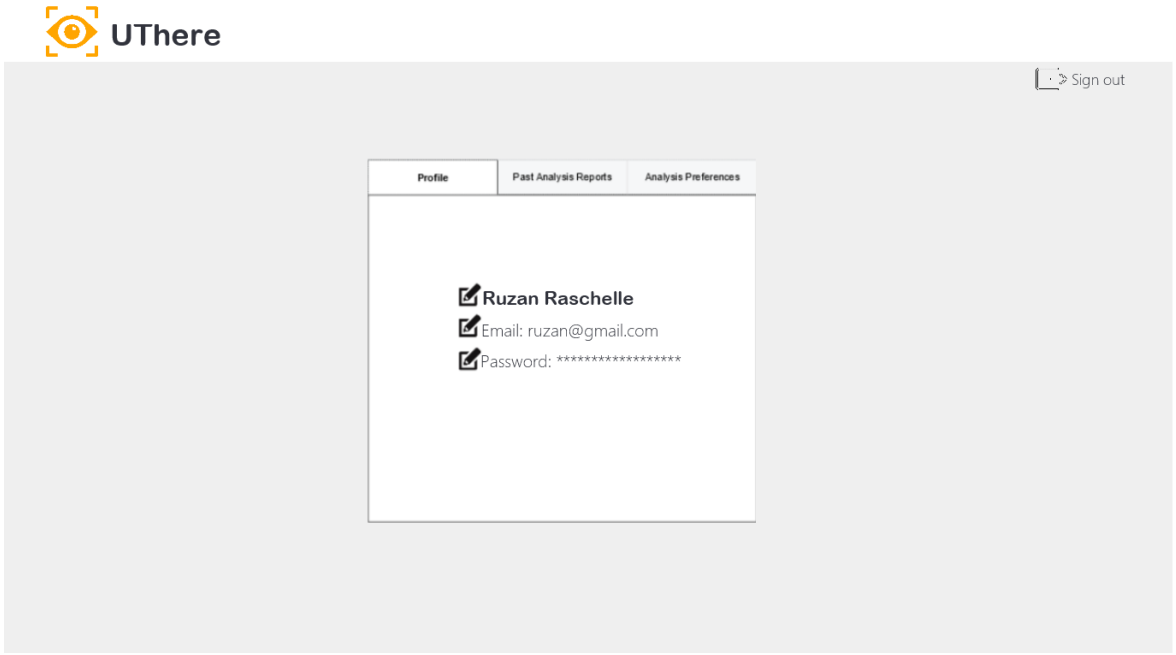
3.5.5.15 Answer Poll Host



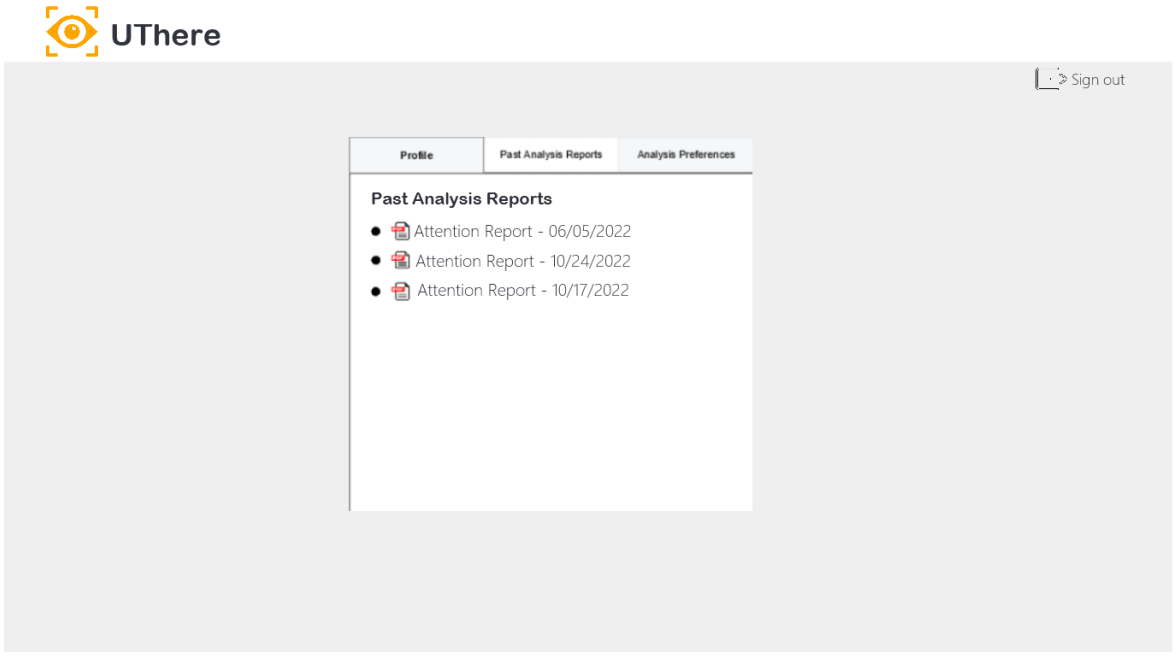
3.5.5.16 End of The Meeting Host Share Analysis Report



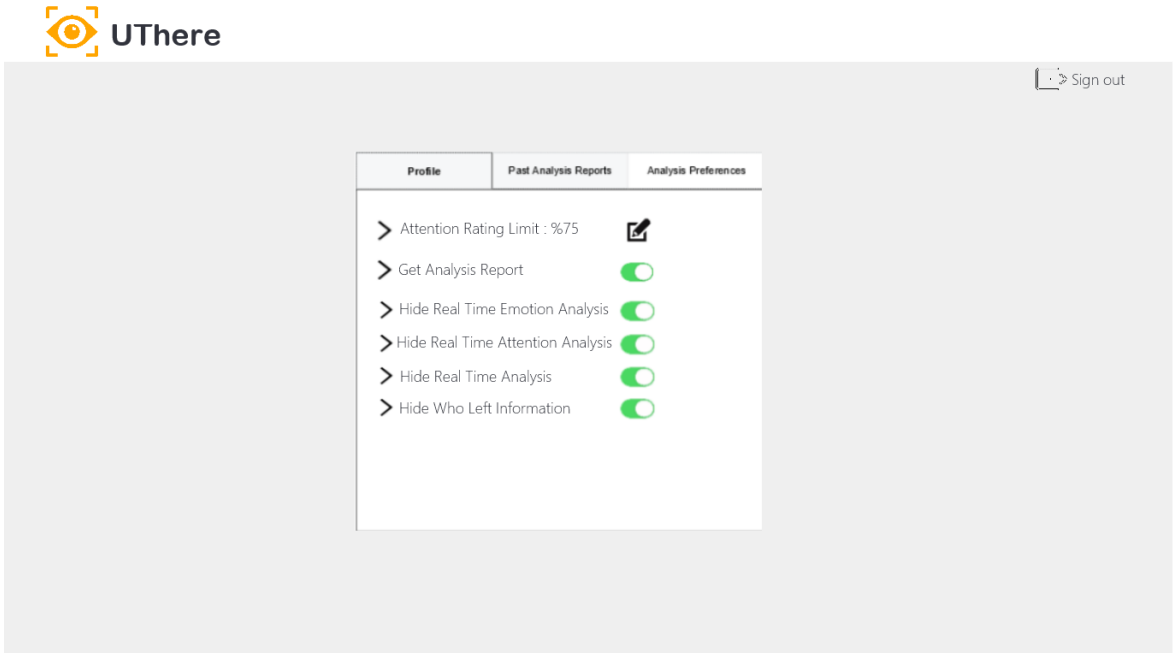
3.5.5.17 Profile Information



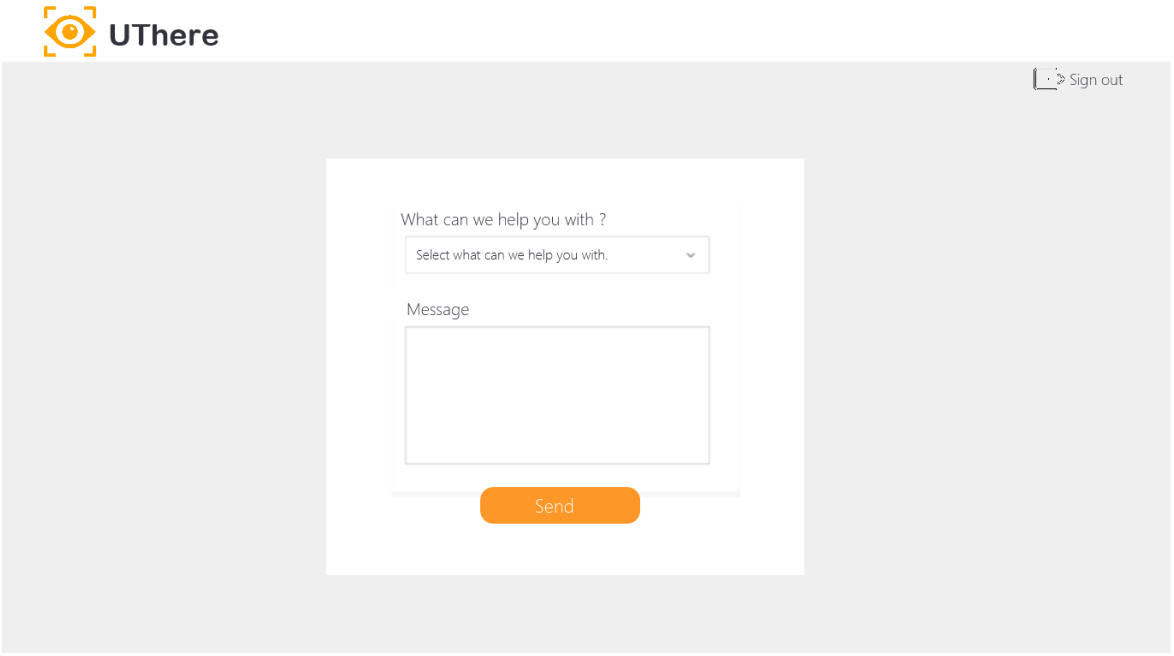
3.5.5.18 Past Analysis Reports



3.5.5.19 Analysis Preferences



3.5.5.20 Contact Page



4. Other Analysis Elements

4.1. Consideration of Various Factors in Engineering Design

4.1.1 Public Health

Online meetings can be exhausting for people when they need to attend to them constantly. This exhaustion can be both physical and psychological. Psychological exhaustion is mentioned as "video conference fatigue" in the paper published about the effects of video conference fatigue on the participants' mental health during the COVID-19 era [10]. Video calls require more mental processing than face-to-face interactions because it is harder to process non-verbal cues such as facial expressions, the tone and pitch of the voice, and body language [11]. UThere aims to ease these processes by providing real-time analysis. By using UThere, users should be able to experience less fatigue because they won't need to focus on people's reactions during their presentations.

Moreover, there might be some additional features added in order to minimize the negative impact of video conferencing. There might be a time limit for each meeting and notifications should be sent to the host when this limit is exceeded. Another feature might be about adjusting the user interface of the meeting room by the audience. They may be

able to choose to see only the presenter's video and screen if that helps them to focus easier. Automated attention and emotion analysis will carry out this job for them.

4.1.2 Public Safety

The biggest risk of video conferencing is exposing users' sensitive information. In order to prevent this, UThere will not permanently keep the meeting recordings of the users. Only the analysis results will be kept in the database if users are willing to acquire them later. If they want to delete their analysis from UThere permanently, they can download the report of the analysis in pdf form and delete the analysis from their account.

Another aspect of video conferencing in terms of safety is about keeping the meetings secure. There should be some authentication process during joining the meetings. We are planning to implement this authentication feature with the help of Agora SDK. Another useful feature to ensure safety might be enabling the host to mute participants or remove them out from the meeting. In this way, unwanted people can be suspended from the meetings.

4.1.3 Public Welfare

There is no effect of public welfare on UThere because it is a web application that will be used by individuals for their personal usage.

4.1.4 Global Factors

There is no current global factor that should be considered during the design of the UThere. However, COVID-19 could be given as an example that shaped the video conferencing tools' functionalities and design enormously. So it can be suggested that there might be new occurring needs as a result of global factors in the future. That is why UThere should be implemented in a scalable manner.

4.1.5 Cultural Factors

There might be different communication styles among the different cultures. In the study of culture, specific countries fall on the context spectrum. This spectrum is a cultural dimension that can be used to explain variations in communication across cultures [12]. As a result of this difference, there might be differences between people in terms of their gestures during the meetings. While the high-context communication style tends to be more expressive with gestures, in the low-context communication style gestures are less expressive. This will be considered during the implementation of the attention and emotion analysis in UThere. If the dataset for emotion recognition includes people from different cultures, the analysis result would be more accurate.

4.1.6 Social Factors

Humans can have social biases and this is one of the main risks of Artificial Intelligence. While implementing UThere's attention and emotion analysis algorithms, we should be careful about potential biases. This analysis should not be affected by the people's race, gender, or age. For emotion recognition, this can be done by using a more inclusive dataset. For the attention analysis, traits that will be used to determine the attention scale should be independent of race, gender, or age. We will track eye gaze, eye blick, and lip movements which can not cause a bias.

4.1.7 Economic Factors

UThere targets both businesses and education participants as a user group. Economically, it is more feasible for businesses to pay for UThere services while for the users who will use UThere for educational purposes it is less likely. Due to this reason, UThere should be free of charge initially. If there would be potential additional services required by the businesses, there might be different plans for the different user groups. There might be UThere Enterprise which will require a monthly or annual payment subscription and provides extra features.

Factor	Effect Level	Effect
Public Health	8	Warnings for the meeting time, setting analysis preferences
Public Safety	6	Ability to delete analysis, ability to remove user from the meeting
Public Welfare	0	None
Global Factors	2	Scalable development
Cultural Factors	4	Using more inclusive dataset
Social Factors	5	Removing the biases
Economic Factors	2	No fees for the application until some point. Enterprise

		version when needed.

4.2. Risks and Alternatives

UThere offers to process and analyze the attention level and emotional status of participants of a presentation, and to give a real-time report to the presenter. However, since image processing algorithms will process each video frame of several participants, the analysis result might be delayed according to the performance of the models and algorithms. Also, sending the data to the server to process might lead to another response delay. Therefore, at this stage, we decided to service a limited number of users in order to decrease the response time and provide the presenter with the report in as real-time as possible. If the delay exposed is not much significant and does not affect the functionality of UThere, the number of users serviced will be increased.

Another risk of the project is the accuracy rate of the models and algorithms. At this point, existing data sets will be used. If the data sets for attention level in facial expressions do not meet our expectations and are not sufficient to train models, we will create our own data set focusing on the attention level evaluation of facial expressions in order to increase the accuracy of estimations.

There is also a technical risk, which is about Agora SDK. Since none of us has used it before or has experience in video conferencing application development, we might end up not meeting our expectations using Agora SDK. As we have researched so far, it enables us to develop the functionality we need for UThere. However, if we face with a video-conferencing feature that is not supported by Agora SDK, we might switch to developing the video conferencing application from scratch.

Finally, it can be thought that being watched during the presentation might have negative effects on the attention and concentration level of the presenter. However, according to research conducted at John Hopkins University in 2018, being watched can trigger "activity in the ventral striatum, an area of the brain that motivates action and motor skills" [13]. Though if any decrease in the attention level of the presenter is observed, an optional feature of hiding the real-time feedback and displaying the results only at the end of the presentation might be launched.

Risks	**Likelihood**	**Effect on the project**	**Solution/Alternative**
Analysis and response delay	8/10	Analysis result becomes not synchronous with the instant video frames and it can misguide	Limited number of users will be serviced.

		the presenter, resulting in decreased functionality.	
Accuracy rate of the models and algorithms	6/10	The system can draw an incorrect conclusion about the attention level of the presentation and misguide the presenter, resulting in decreased functionality.	A new data set can be created.
Impracticability of Agora SDK	2/10	Video conferencing applications might not provide the desired features, resulting in decreased usability.	Other SDK can be used or video conferencing application can be implemented from scratch.
Having negative effects on the attention level	3/10	Contrary to what the application aimed, the services provided might distract users and decrease attention level.	Users can hide real-time analysis if they wish.

4.3. Project Plan

WP#	Work Package Title	Members Involved
WP1	Project Specification Report	All Members
WP2	Analysis and Requirements Report	All Members
WP3	Presentation and Prototype Demo	All Members
WP4	Detailed Design Report	All Members
WP5	Final Report	All Members
WP6	Presentation and Demo	All Members
WP7	Implementation of Video-Conferencing Web Application	All Members
WP8	Implementation of Machine Learning and Image Processing Algorithms	All Members

The explanation for each work package is given below:

WP1: Project Specification Report	
Start Date: 27.09.2022	**End Date:** 17.10.2022
Members Involved: All members	
Objectives: ● Deciding on the project topic ● Writing Project Specification Report	
Tasks: ● **Project Topic Selection:** Deciding on the project topic among several project topic candidates. Arranging a meeting with Ayşegül Dündar, Erhan Dolak and Tağmaç Topal and getting their opinions about our project topic. ● **Innovation Expert Meeting:** Arranging a meeting with Çağla Çığ Karaman to get feedback and her opinion about our project topic. ● **Project Specifications:** Determining the functional and nonfunctional requirements, constraints and possible risks. Assigning a name to the project.	
Deliverables: **D1.1:** Project Specification Report **D1.2:** Innovation Expert Evaluation Form **D1.3:** Project Website	

WP2: Analysis and Requirements Report	
Start Date: 18.10.2022	**End Date:** 13.11.2022
Members Involved: All members	
Objectives: ● Making a detailed analysis and specifying the requirements of the project	
Tasks: ● Researching the currently existing products similar to our project(Market Research) ● Redefining the functional and nonfunctional requirements, and constraints ● Explaining all possible scenarios within the system ● Creating a use case diagram ● Creating an object and class Model ● Creating activity diagrams ● Creating sequence diagrams ● User interface design ● Specifying the possible risks and the actions that will be taken accordingly ● Planning the rest of the project and distributing the tasks among team members	
Deliverables:	

D2.1: Analysis and Requirements Report

WP3: Presentation and Prototype Demo	
Start Date: 14.11.2022	**End Date:** 15.12.2022
Members Involved: All members	
Objectives: ● Implementing the basic functionalities in order to prepare a presentable prototype	
Tasks: ● Creating the video-conferencing web application with basic functionalities ● Configuration of Agora SDK, Django and React.js ● Implementing the most basic machine learning and image processing algorithm	
Deliverables: **D3.1:** Prototype and Presentation	

WP4: Detailed Design Report	
Start Date: 30.01.2023	**End Date:** 19.02.2023
Members Involved: All members	
Objectives: ● Explaining the design trade-offs ● Writing the detailed design report	
Tasks: ● Decomposing the system into subsystems and creating a multi-layer application ● Determination of security and boundary conditions ● Defining the interfaces and design patterns to be used	
Deliverables: **D4.1:** Detailed Design Report	

WP5: Final Report	
Start Date: 20.02.2023	**End Date:** 30.04.2023
Members Involved: All members	
Objectives:	

● Writing the final report
Tasks: ● Finalizing the project and preparing a final report
Deliverables: **D5.1:** Final Report

WP6: Presentation and Demo	
Start Date: 30.01.2023	**End Date:** 08.05.2023
Members Involved: All members	
Objectives: ● Implementing the all functionalities of the project and presenting through a demo	
Tasks: ● Finalizing the video-conferencing web application giving accurate feedback to the presenter about the attention level of the participants through machine learning and image processing algorithms	
Deliverables: **D6.1:** Presentation and Demo	

WP7: Implementation of Video-Conferencing Web Application	
Start Date: 14.11.2022	**End Date:** 08.05.2023
Members Involved: All members	
Objectives: ● Implementing the user-friendly web application interface ● Embedding real-time voice and video into the web application through Agora SDK ● Connecting Agora SDK, backend written in Django and frontend written in React.js by the help of REST framework.	
Tasks: ● Hands-on experience on React.js and designing the web pages ● Learning Django-React full stack web application development ● Implementing the frontend ● Implementing the backend ● Setup of Agora SDK ● Designing the database schemas ● Constructing the database and setting up Google Cloud ● Testing the basic functionalities of video-conferencing web application on each component	

Deliverables:
D7.1: A video-conferencing web application providing basic functionalities

WP8: Implementation of Machine Learning and Image Processing Algorithms	
Start Date: 21.11.2022	**End Date:** 08.05.2023
Members Involved: All members	

Objectives:
- Deciding on how attention score will be evaluated
- Deciding on the ML and image processing algorithms to be used
- Conducting model trainings and evaluations
- Displaying the outcomes of the algorithms on the user interface

Tasks:
- Collecting a dataset for emotion recognition and attention scoring tasks
- Decision of the ML models and Image Processing algorithms
- Learning OpenCV, PyTorch and TensorFlow
- Conducting data preprocessing and augmentation
- Model trainings and evaluation
- Testing emotion and attention analysis on real time

Deliverables:
D8.1: Attention level and emotional status analysis algorithms


ID
Name
2022
2023
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Apr 2023
May 2023
1 Project Specification Report
7 Project Topic Selection
8 Innovation Expert Meeting
9 Project Specifications
2 Analysis and Requirements Report
10 Market Research
11 Redefining functional, nonfunctional require...
12 User Scenarios
13 Use case Diagram
14 Object And Class Diagram
15 Activity Diagrams
16 Sequence Diagrams
17 UI Design
18 SWOT Analysis
19 Task Distribution
3 Presentation and Prototype Demo
20 Web Application Authentication
21 React Django Integration Through Django R...
22 Agora Configuration
23 Implementing Basic ML and Image Processi...
4 Detailed Design Report
24 System Decomposition And Multi-layer Impl...
25 Security Testing
26 Interface And Design Patterns
5 Final Report
27 Project And Report Finalization
6 Presentation and Demo
30 Web application and ML implementation Fin...
28 Video-Conferencing Application Implementation
31 React And Web Page Design
32 Django Full Stack Development
33 Front-end Implementation
34 Back-end Implementation
35 Agora SDK Setup
36 Google Cloud Setup
37 Design of DB Schemas
38 Unit Testing
29 ML and Image Processing Implementation
39 Emotion And Attention Dataset Collection
40 ML Model And Image Processing Design De...
41 Learning OpenCV, PyTorch and TensorFlow
42 Conducting data preprocessing and augmen...
43 Model trainings and evaluation
44 Testing emotion and attention analysis on re...

4.4. Ensuring Proper Teamwork

- **Discord & Whatsapp:** Discord and WhatsApp are being used as communication channels. WhatsApp is used for less important and urgent matters such as meeting planning or fast communication. Discord is being used for having weekly meetings and also to make video calls, when face-to-face meetings are not possible, to discuss important matters of the project and collaborate.

- **Trello:** Trello is a project management tool for tracking project development. The work assigned to team members is accessible through Trello.

- **Weekly Meetings:** We will be having regular weekly meetings, usually on fridays, to catch up and analyze where we are standing and have a clear vision of the progress.

- **GitHub:** GitHub is used for version control. Allowing us to collaborate on different branches will make it possible to track the work done and collaborate effectively.

- **Experience based leadership and work allocation:** Any of the group members have an area of expertise and will provide help and feedback for the other team members.

- **Pair programming/planning:** Open to discussion parts of the project such as small design decisions (features, object and class models, etc.) will be done in pairs. Moreover, any part of the project involving complex algorithms will be done through pair programming.

- **Collective ownership:** There will be no area-specific work allocation to anyone such as working only on the backend, frontend, or machine learning. Especially in the development stage, the allocation will be based on scenarios. All team members will take part in all of the crucial development stages. Therefore, all group members take responsibility for the project equally. Anyone can change anything by discussing it with the group members.

4.5. Ethics and Professional Responsibilities

In UThere, since the process is based on users' facial expressions, it is crucial that their privacy will not be violated for us to comply with ethical rules. In the database system, photos or videos of the users will not be held to respect the privacy of the users. Only data that are related to the emotions of the users will be stored for analyzing and offering analyzed information to the presenter. Collected data will not be shared with any third party companies for business purposes.

The protection of data becomes more significant over time. To process the data of the users, it is important to conform to the purpose limitation principle which means that data of the users can be collected or used for specific necessary purposes. These purposes also have to be transferred to the data owner in a well-defined way. Hence, UThere will collect the necessary data of the users when it is approved by users.

During implementation, when an open source software is used, it is important to take into account licensing it. These packages may have some disadvantages in terms of privacy. Some of the licenses ask to share all of the enhancements [14]. To avoid violation of privacy, licenses that do not require sacrifices will be chosen when it is needed.

4.6. Planning for New Knowledge and Learning Strategies

There are 3 main parts in the development process of UThere. The members of the team should acquire new knowledge to complete the project. Since UThere is a web-based application, the team will work on both front-end and back-end of the project. For the front-end side of the project, the team decided to use React.js as a Javascript library. Some of the members in our team (İlke and Bilgehan) used React.js in their previous projects. However, in this project, the team decided that every team member should have the basic knowledge about the technology used in UThere. To enable real-time video conferencing, we will use Agora.io. Agora.io is used to create real time communications such as video-conferencing in both web and the mobile applications [15]. It has cross-platform Software Development Kits (SDK) and React.js is one of these platforms that Agora APIs can be used [16]. None of the members used Agora before. As a learning strategy to acquire required knowledge about Agora, we will use both the documentation given on its website and youtube tutorials that create basic WebRTC applications by using Agora.io [17] [18].

For the back-end part of this project, we decided to use Django. Django is a python-based web framework [19]. As in the front-end part, some of the team members(Kimya and Melike) used Django in the previous projects. However, most of us are not familiar with this framework. As a learning strategy for the web part, we will use online courses. From Udemy, we found a full stack course that uses both React.js and Django [20]. This course will help us in the web development process.

The final part of UThere is the most important one in terms of the functionality of the project. To measure the attention level and the emotional status of the participants in a meeting, we need to use machine learning and computer vision algorithms. Melike, Yuşa and İlke had prior basic knowledge about basic computer vision algorithms since they took a computer vision course in Bilkent. Besides that, Bilgehan, İlke and Melike have basic machine learning knowledge since they took the machine learning course in Bilkent. However, none of them previously worked on a project which requires eye tracking, emotion analysis, etc. Therefore, to acquire this knowledge, for the ones who are not familiar with machine learning algorithms, we will use youtube tutorials. For others, we will research the machine learning and computer vision

algorithms that work efficiently in real-time in the literature. Besides, to find a comprehensive dataset, we will look at web-based data-science environments such as Kaggle.

5. Glossary

REST framework: Django has a framework named REST, which is a powerful and flexible toolkit for building Web APIs [21].

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