



**CS 492**

**Senior Design Project**

Design Project Final Report

*T2315*

*SummarEyes*

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## 1. Introduction

In the past decade, video conferencing has become an indispensable tool for real-time communication, spanning various domains from corporate meetings with remote teams and multiple office locations to educational settings like workshops, training sessions, and university lectures. The shift toward online education, accelerated by recent global events and extraordinary circumstances, has underscored the versatility and necessity of this technology. While video conferencing reduces travel expenses, enhances productivity, and fosters collaboration, it is not without its challenges, particularly in maintaining participant engagement and personal interaction, which are crucial for effective communication.

Recognizing these challenges, SummarEyes aims to refine the online meeting experience by addressing key areas where video conferencing can fall short. SummarEyes takes a comprehensive approach by offering intelligent meeting summaries and detailed attention

analysis. This not only aids presenters in understanding audience engagement but also provides participants with a comprehensive recap of the meeting, ensuring that key points are retained and understood.

SummarEyes leverages advanced algorithms to analyze engagement levels, identifying moments of high or low attention based on participants' visual cues. This information can be invaluable for presenters, offering insights into which aspects of their presentation resonate most and where attention may wane. Additionally, SummarEyes incorporates sophisticated summarization techniques, distilling the essence of meetings into concise, actionable insights that can be reviewed at a glance.

By integrating these features, SummarEyes aspires to elevate the effectiveness of video conferencing, making it a more interactive and productive tool. The goal is not just to enhance the experience for presenters but to also enrich the learning and collaborative environment for all participants. In embracing the potential of video conferencing, SummarEyes is committed to developing a solution that balances the convenience of digital communication with the nuanced dynamics of personal interaction, striving to create a more engaging and insightful virtual meeting space for everyone involved.

## **2. Requirements Details**

### **2.1 Functional Requirements**

#### **2.1.1 User**

- **Registration:** Users can sign up for the platform by providing required personal details such as username, email, password, first name and last name and setting up login credentials.
- **Login/Logout:** Users have the ability to securely log in to access the platform and log out to maintain data security.
- **Data Usage Permission:** Upon registration or initial login, users will be prompted to consent to the platform's use of their personal data, including camera and microphone feeds, to comply with privacy regulations.
- **Profile Management:** Users can view and edit their profile information.
- **Create a Meeting:** Any user can host a new meeting and invite other users by sharing the meeting id.
- **Join a Meeting:** Any user can join a meeting using the corresponding meeting ID.
- **Contact:** Users can send their complaints/requests to the admins.
- **Subscription Plan:** Users can change their subscription plan to unlock more features of the application such as having unlimited personalized summaries or feedbacks.

### **2.1.2 Participant**

- Audio/Video Settings: Participants can manage their audio and video settings during meetings.
- Leave Meeting: Participants can leave meetings as needed.
- Meeting Interaction: Participants have the capability to view other participants during the meeting.
- View Summaries: Participants can download both default and customized summaries of meetings they have attended.

### **2.1.3 Host**

- End a Meeting: Hosts have the authority to end the meeting for all participants, ensuring an orderly conclusion to the session.
- Manage Participants: Hosts can view participants and have the ability to invite or remove participants from the meeting.
- View Summary/ Feedback: Hosts can access and download default summaries and feedback reports post-meeting to review participant engagement and their own performance.

### **2.1.4 Organization**

- Subscribe to Plan: Organizations can choose and manage subscription plans according to their needs.
- Organizational User Management: Organizations have the authority to add users to or remove users from their organizational structure within the platform.

### **2.1.5 Admin**

- Manage User Accounts: Admins are responsible for the management of user accounts within the system, including General Users, Participants, and Hosts.
- Access Reports: Admins can access detailed reports related to user activities, meeting analytics, and system usage.

## **2.2 Non-functional Requirements**

### **2.2.1 Usability**

The system prioritizes a user-centric design, providing an intuitive interface that accommodates users of varying expertise. The process for account creation, meeting management, and feature utilization should be streamlined and clear. The system's layout will adopt a minimalist approach, reducing cognitive load and

potential user errors. Accessibility to instructions and support documentation will be a click away, enhancing user comfort with data usage and system functionalities.

### **2.2.2 Reliability**

The system's reliability remains paramount, ensuring consistent delivery of precise meeting summaries and robust performance under diverse operational conditions. It will support a wide range of languages and dialects accurately, and maintain high-quality processing regardless of audiovisual variations. A commitment to continuous operation will be upheld, with the system demonstrating a high availability quotient to meet user scheduling and participation needs.

### **2.2.3 Performance**

Performance optimization is crucial, with the system capable of swiftly processing and analyzing data to provide post-meeting summaries efficiently. The analysis algorithms will operate discreetly in the background, preserving meeting integrity and participant experience. The system will be fine-tuned for varying internet bandwidths, providing a stable experience for all users, irrespective of their network conditions.

### **2.2.4 Supportability**

The system's life cycle will be supported by regular updates and a dedicated support team, addressing technical inquiries and user feedback proactively. The infrastructure will be designed for straightforward maintenance and updates, minimizing service interruptions and ensuring the system evolves in line with technological advancements and user feedback.

### **2.2.5 Scalability**

Scalability is designed into the system's architecture, ready to accommodate growth in user numbers, meeting frequency, and data throughput. The infrastructure will be capable of scaling up to meet increased demand while preserving performance levels. The system's roadmap includes provisions for future feature enhancements and capacity expansions to remain adaptable and forward-facing in the dynamic tech environment.

### **2.2.6 Robustness**

The system will remain stable under various stress conditions, whether due to high user load, large data processing demands, or network variability. Also the system will include robust recovery mechanisms that enable quick restoration of service in the event of failure, with minimal impact on the user experience and data loss.

## **3. Final Architecture and Design Details**

### **3.1 Overview**

This section fully explains the suggested software architecture. Software architecture is a foundational framework essential to comprehending software systems and offering a path for their advancement. The main elements of the software architecture, such as subsystem decomposition, hardware/software mapping, persistent data management, access control, and security, are briefly reviewed in this section.

### **3.2 Subsystem Decomposition**

Subsystem decomposition, which divides complicated systems into more manageable, coherent pieces, is essential to organizing a software application's design. This method makes testing and development easier while also making it clearer who is responsible for what in the system. The diagram's breakdown illustrates how the system is divided into three main subsystems, each responsible for certain functions that combine to offer the whole range of the application's capabilities.

Along with the Meeting interface, the Interface Subsystem provides the front end of user interaction. It has features like Login/Sign Up, Dashboard/Profile, Summaries/Feedbacks, and Organization/Subscription administration. This subsystem, which aims to offer a smooth and simple user experience, acts as the user's entry point to the program.

The Server Subsystem, which serves as the system's operational hub, is at its heart. It may be accessible via an API Gateway, which guarantees effective and safe communication between services. The Meeting Service manages the practicalities of running sessions, the Authentication Service confirms user credentials, and the Summary Service compiles and produces meeting summaries.

Last but not least, the Data Subsystem is fundamental, providing strong data management capabilities to support the application. This subsystem offers an organized method for organizing, saving, and retrieving data through the Database Manager, which is essential for the application's performance and integrity.

The figure illustrates the modular structure of the program by isolating distinct subsystems, which allow each subsystem to be built, scaled, and maintained separately while still maintaining the overall coherent function of the system.

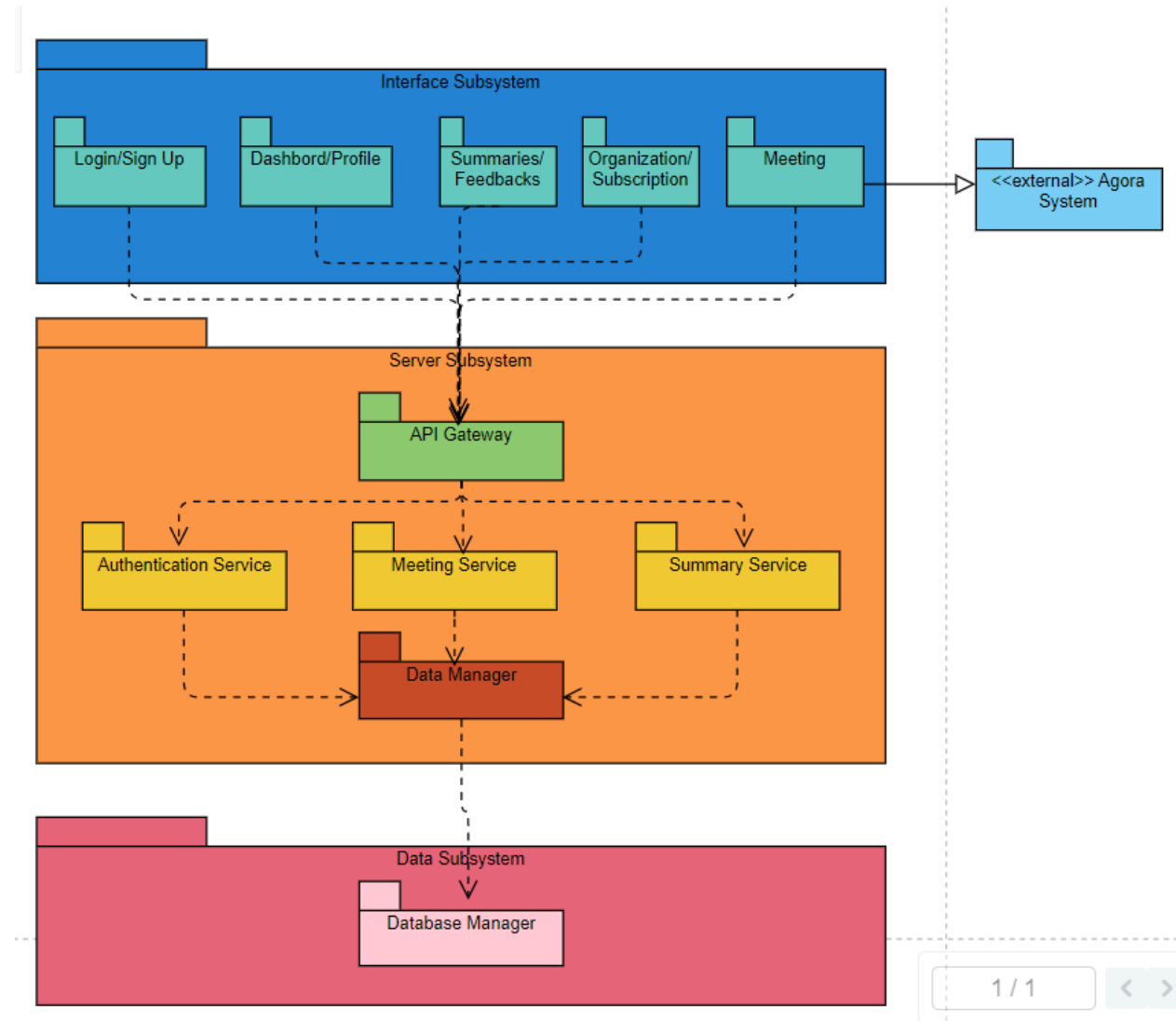


Figure 1: Subsystem Decomposition

### 3.3 Hardware/Software Mapping

The hardware/software mapping in the SummarEyes project's architecture is carefully thought out to guarantee logical interactions between different system components. The



architectural diagram makes it evident how software services are deployed and linked to their appropriate hardware settings. The Authentication Service, Meeting Service, and Summary Service—which together comprise the core of the application's server-side logic—are supported by the Heroku Server, which is at the center of the infrastructure. The program uses a scalable and dependable S3 Bucket hosted by Amazon Cloud to store meeting recordings, which are necessary for the summarizing functionalities. On the client side, users connect to the Web Server, which supports the Frontend Client, and engage with the system using a web browser and devices with cameras.

Through the processing of HTTP requests by an API layer, this client interfaces with server-side components to provide a smooth user experience and data flow. Agora Server integration is another feature of the design that highlights the system's resilience to real-time media interactions. Every connection—whether via the TCP/IP or HTTP protocols—is meticulously set up to enable effective data flow. Software settings and, eventually, the software components' deployment are influenced by the underlying hardware. The SummarEyes platform's best performance and scalability depend on this strategic alignment between hardware and software.

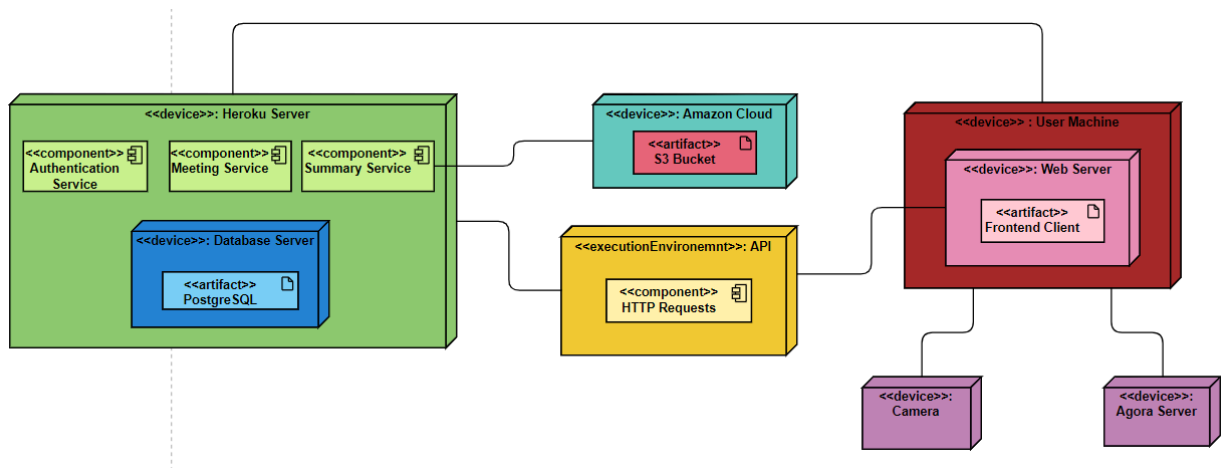


Figure 2: Hardware & Software Mapping

### 3.4 Persistent Data Management

Strategic choices were taken throughout the SummarEyes application's development lifecycle to guarantee effective and safe persistent data storage, according to our application's needs for processing video data for emotion analysis.

First, we realized that to make emotion analysis easier, user video recordings need to be temporarily stored. We used Amazon S3 cloud storage to manage massive amounts of video footage while navigating privacy concerns. With this approach, we can prioritize

user privacy and effective data management while maintaining high speed and accessibility. Videos are erased soon after processing.

We chose a robust database system that could effectively manage the varied and large amounts of data related to video analysis to accommodate the large amount of data produced by our application, including the results of emotion analysis. This makes the SummarEyes application reliable and scalable.

In addition, keeping meeting summaries is a crucial component of our data strategy. These summaries, which highlight significant ideas and feelings from the discussions, are produced after emotion analysis. We improve the usability and user experience of the program by giving users valuable context and actionable information by preserving these summaries.

We have a separate data manager layer in our system architecture that abstracts the complexity of working with the database and cloud storage, making it possible to perform simple tasks like storing meeting summaries and temporarily storing videos, retrieving them for emotion analysis, and then deleting them. This layer enhances the flexibility and effectiveness of our data-handling strategy by separating application logic from data management responsibilities.

### **3.5 Access Control and Security**

SummarEyes places a high priority on protecting user data privacy and security, especially in light of the sensitive nature of meeting summaries and recordings. SummarEyes uses a strong access control and security approach that includes role-based access control (RBAC), data encryption, and authentication to reduce any possible security risks.

To begin with, SummarEyes uses a safe authentication system to confirm users' identities. During the login procedure, each user's role—administrator, team member, or ordinary user—is authenticated. Users may access just the features and information relevant to their rights within the system thanks to role-based authentication. An administrator may, for example, be able to see the entire system, but individual users would only be able to view their own meeting summaries.

Secondly, SummarEyes uses strong encryption techniques to protect data while it's in motion and at rest. Advanced encryption standards are used to secure meeting recordings kept in S3 buckets, and encryption is also used to protect analytical data sent to the servers from interception and illegal access. This method guarantees that the data is safe and unreadable even in the improbable case of data interception.

And last, the SummarEyes platform carefully applies RBAC. The system restricts user access to various areas of the program according to their responsibilities by using fine-grained permissions. To make sure that every user interaction with the system is compared to the user's authorized activities, access control lists and, where needed, custom decorators are used in the application's codebase to enforce this. Ensuring that sensitive data, such as summarized meeting insights, is only accessible to authorized users through extensive access control is crucial for preserving the integrity and security of data inside the SummarEyes ecosystem.

## **3.6 Subsystem Services**

UThere uses a 3-tier architectural pattern that implements the client-server model. There are three computing tiers in this architectural pattern: Presentation Tier, Application Tier, and Data Tier [1]. The presentation tier is the user interface tier. Its goal is to handle client requests and provide information to clients[1]. The application tier is the logic tier of the application that gets the data that comes from the client, processes and stores it by communicating with the data tier, and sends it back to the presentation tier [1]. The data tier stores the data and consists of the database servers [1].

In the UThere system, the presentation layer serves as the client and requests resources or services from the application layer, which serves as the server in client-server relations. In other words, the UThere system has three main subsystems as mentioned in Figure 1.

### **3.6.1 Client-side Subsystem**

SummarEyes, embodying the interface tier in a three-tier architectural pattern, facilitates direct interaction with its users. This tier plays a pivotal role in requesting and displaying data from the application logic tier, ensuring a seamless user experience. Additionally, it is responsible for sending user input back to the application logic layer for further processing and storage. As depicted in the accompanying diagram (See Figure 3), the SummarEyes interface is subdivided into seven distinct subsystems, each specializing in specific aspects of user interaction and data management, thereby contributing to the overall functionality and efficiency of the system.

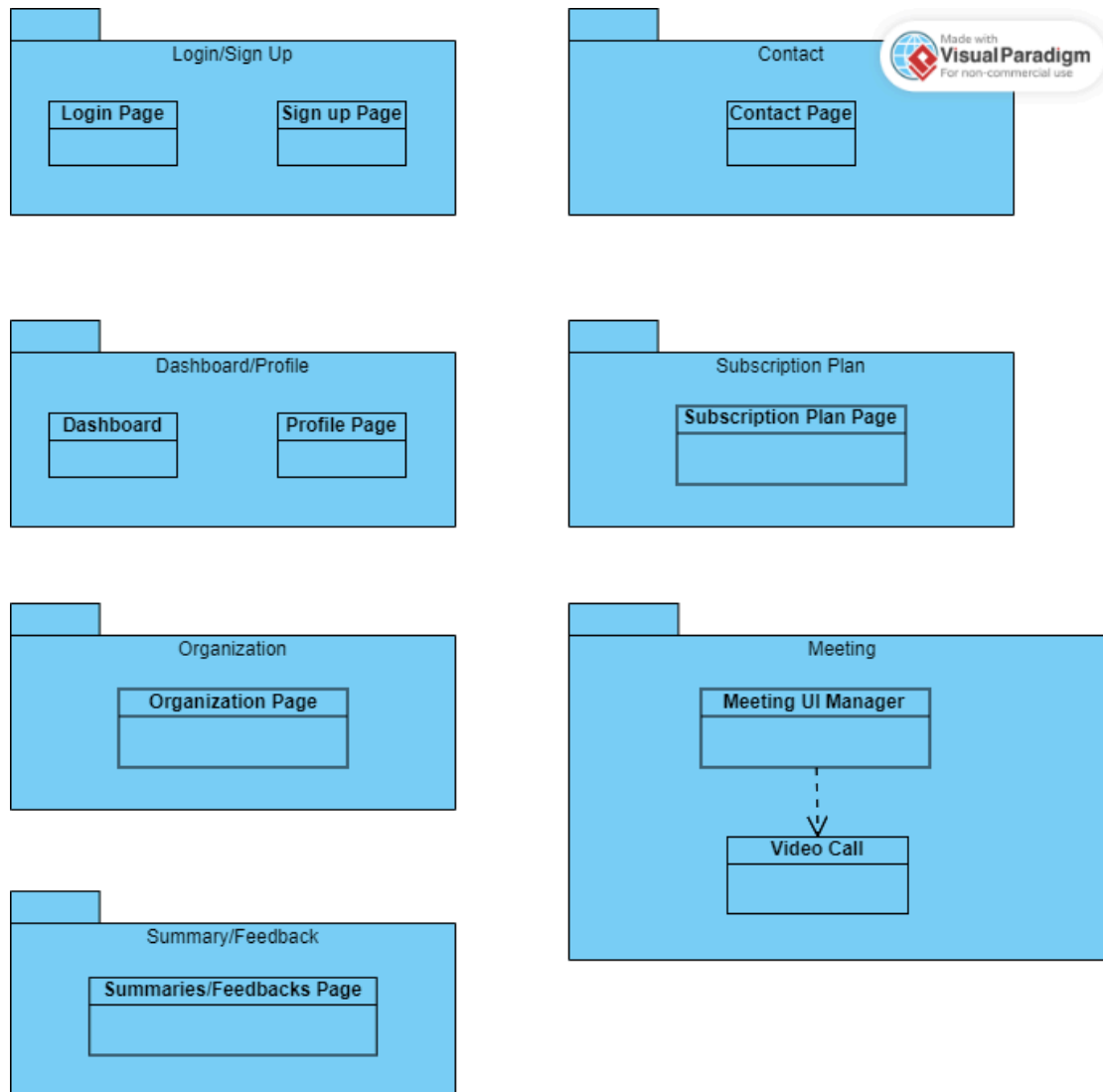


Figure 3: Client-side Subsystem Diagram

### 3.6.1.1 Login/Sign Up

When users enter the SummarEyes website, they are first directed to the 'Login Page,' where existing users can enter their credentials to access their accounts. For new users who don't have an account, there is an option available, labeled 'Don't have an account? Sign Up,' located below the login fields. Selecting this option takes them to the 'Sign Up' page, where they can register by providing the necessary information. Both the 'Login' and 'Sign Up' pages are integral for user interactions, capturing essential details like login credentials and registration information. Most of this data is subsequently sent to the application logic tier for processing, ensuring a seamless integration of user management within the system.

### **3.6.1.2 Dashboard/Profile**

Upon successfully logging in, users are directed to their 'Dashboard Page', which serves as the central hub for navigation within the system. From here, users can access various features, including their profile. By clicking the profile button, users are taken to the 'Profile Page' where they can view and edit their personal information. This page interacts with the Application logic tier to retrieve and update user profile details. Additionally, if a user wishes to adjust their settings or review other account-related information, the Profile Page continues to facilitate these requests by interacting with the application logic tier for data retrieval and update submissions.

### **3.6.1.3 Organization**

The 'My Organization' page is a significant feature designed for users who are either owners or members of an organization. Accessible from the user's Profile Page, this section provides a centralized platform for managing and participating in organizational activities. When a user navigates to the 'My Organization' page, the Application Logic Tier plays a crucial role in presenting the relevant information based on the user's role within the organization. For owners, it displays options for managing the organization, such as adding members, assigning roles, and overseeing organizational settings. For members, it provides access to organization-specific information and activities. The Application Logic Tier ensures that each user's interaction is processed accurately, reflecting their privileges and responsibilities within the organization.

### **3.6.1.4 Subscription Plan**

Users can go to the "Subscription Plans" page from their "Dashboard". The Subscription Plan feature within our project allows users to choose different levels of service according to their needs. This functionality is managed by the Application Logic Tier, which handles the processing of subscription selections, changes, and renewals. It ensures that the user's choices are correctly applied and that any changes to subscription status are promptly reflected in their access to features and services. The Server Tier plays a vital role in the Subscription Plan feature by securely storing all subscription-related data. It maintains records of user subscription types, payment information, and historical data regarding subscription changes. When a user makes a choice or changes their subscription plan, this tier updates the records accordingly, ensuring data consistency and reliability. The Server Tier is also responsible for integrating with payment gateways and managing the secure processing of subscription fees

### **3.6.1.5 Meeting**

The Meeting subsystem, managed by the 'Meeting UI Manager', facilitates essential video conferencing features accessible from the 'Dashboard Page' to the 'Meeting

Page'. In the Meeting subsystem, the Application Logic Tier plays a pivotal role. It handles the operational logic for starting and managing video conferences, including the camera and microphone controls, and processing the leave meeting requests. This tier also controls the recording of meetings and orchestrates the initial processing of these recordings, preparing them for further analysis. The Server Tier is responsible for securely storing these video recordings and managing the data flow between the Meeting UI and the data storage solutions, ensuring data integrity and security

### **3.6.1.6 Summaries/Feedbacks**

In the 'Dashboard', users will find a dedicated button leading to the 'Summaries/Feedbacks' page. This section significantly enhances the user experience by offering detailed insights into past meetings. Upon navigating to this page, users are presented with a layout where each previous meeting is displayed as a clickable card. Clicking on a card opens up its specific summary, providing a concise and personalized recap based on the emotional responses captured during the meeting. For the Summaries/Feedbacks feature, the Application Logic Tier takes the recorded data from the Server Tier and performs advanced analysis to generate personalized summaries and emotion-based feedback. It processes user interactions on the Summaries/Feedbacks page, retrieving specific meeting data upon request. The Server Tier plays a critical role here by storing all the analyzed data, including the transcripts, summaries, and feedback metrics. It ensures that when a user selects a meeting card on the Summaries/Feedbacks page, the corresponding data is efficiently retrieved and displayed

### **3.6.1.7 Contact**

When the user is navigating within the dashboard, they can access the 'Contact Page' by clicking the contact form button. This page is specifically designed to capture user queries, feedback, or requests. It actively monitors all user interactions within this page, ensuring a responsive and user-friendly experience. Upon submission of the form, the information provided by the user is forwarded to the application logic tier for appropriate handling and response.

## **3.6.2 Server-side Subsystem**

Within the SummarEyes framework, the Application Tier functions as the core component in a three-tier architectural model. This tier operates on the server side, facilitating interaction between the Interface Tier and the Server Tier. It plays a pivotal role in the exchange of data: retrieving information from the Server Tier to fulfill requests from the Interface Tier, and conversely, receiving requests from the Interface Tier and

transmitting data to the Server Tier for storage purposes. As in Figure 4, the client-side subsystem has 3 subsystems.

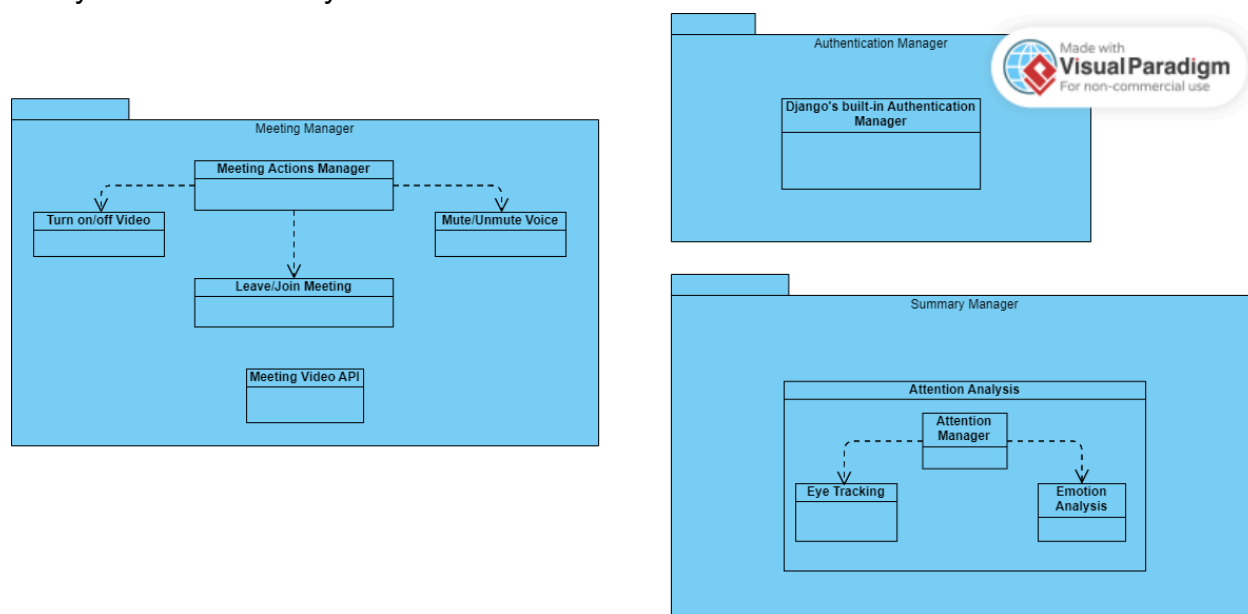


Figure 4: Server-side Subsystem Diagram

### 3.6.2.1 Authentication Manager

The Authentication Manager is the security gatekeeper of our system. It utilizes Django's built-in authentication system to manage user sign-ins, sign-ups, and maintain session security. This manager is tasked with verifying user credentials, providing appropriate access control, and protecting user data through robust authentication protocols. It is an essential component in maintaining the integrity and privacy of our user-centric platform.

### 3.6.2.2 Summary Manager

The Summary Manager handles the compilation and delivery of meeting summaries and feedback. It consists of two primary subsystems: the Attention Analysis and the Emotion Analysis. The Attention Analysis subsystem, guided by the Attention Manager, utilizes eye-tracking data to gauge user attention during meetings. It assesses engagement levels, providing valuable metrics for feedback. Concurrently, the Emotion Analysis subsystem processes emotional cues to enrich the meeting summaries, giving insights into the participant's emotional engagement, using valence and arousal as key indicators.

### **3.6.2.3 Meeting Manager**

The Meeting Manager oversees all aspects related to the virtual meetings. This includes the Meeting Actions Manager, which allows participants to turn on/off their video, mute/unmute their microphones, and manage their presence in the meeting by joining or leaving. Furthermore, the Meeting Video API interfaces with the presentation tier to handle real-time video data, ensuring a seamless video conferencing experience. This manager ensures the reliable execution of meeting-related actions and the integrity of video data management.

## **4. Development/Implementation Details**

### **4.1 Frontend Implementation**

For Frontend, we have used React which is a JavaScript library that follows a component-based approach, allowing developers to create reusable UI components and manage their state independently. To implement video conferencing features, we have used Agora WebRTC SDK for React. We designed the user interface with React components for video display, participant list, screen share and controls. We implemented video conferencing functionalities (joining/leaving a meeting, sharing/muting video or voice etc.) by receiving the user input from components and passing it to Agora SDK's functions.

While designing the frontend UI, we focused on simplicity and user-friendliness, emphasizing the main features. The home screen features six buttons that lead to the most important functionalities of the app. For example, the 'Create Meeting' button allows users to set up new meetings, the 'Join Meeting' button enables them to participate in existing meetings, and the 'Summaries' page provides access to summaries of past meetings (see Figure 5). Additionally, there are buttons for the profile page, contact page, and a page where users can view and subscribe to different subscription plans.

Additionally, to get user consent, we integrated an informational pop-up into the frontend UI that asked for user permission before joining a meeting about recording videos(see Figure 7). This pop-up ensures that users are informed and their consent is obtained, enhancing transparency and trust in the application.



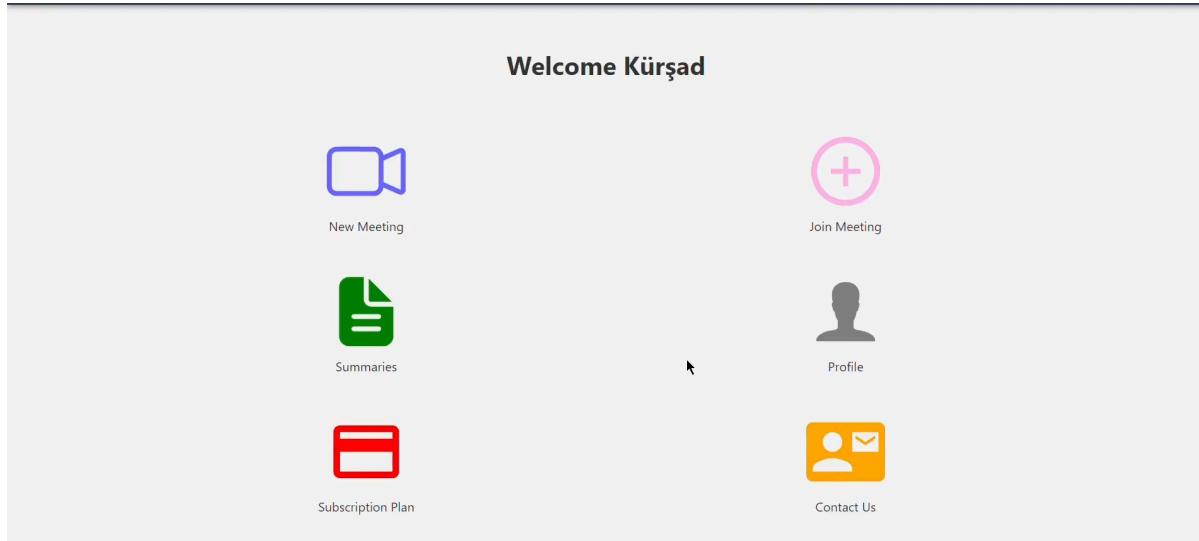


Figure 5: SummarEyes 'Home Page'

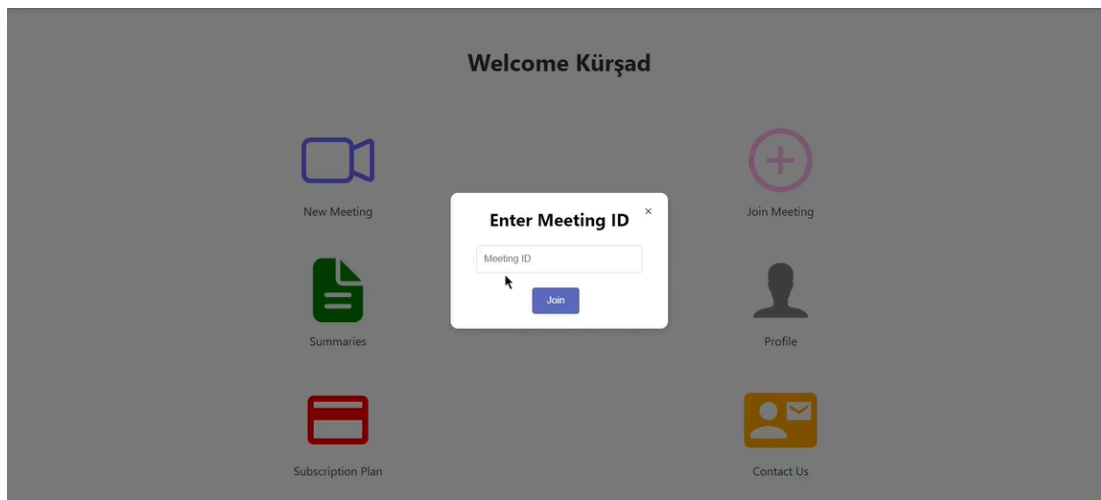


Figure 6: SummarEyes 'Join Meeting Pop-up'

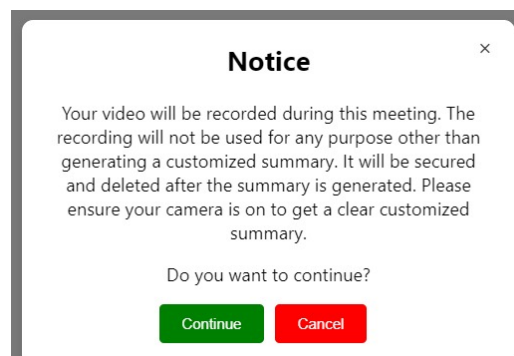


Figure 7: SummarEyes 'Notification Pop-up'

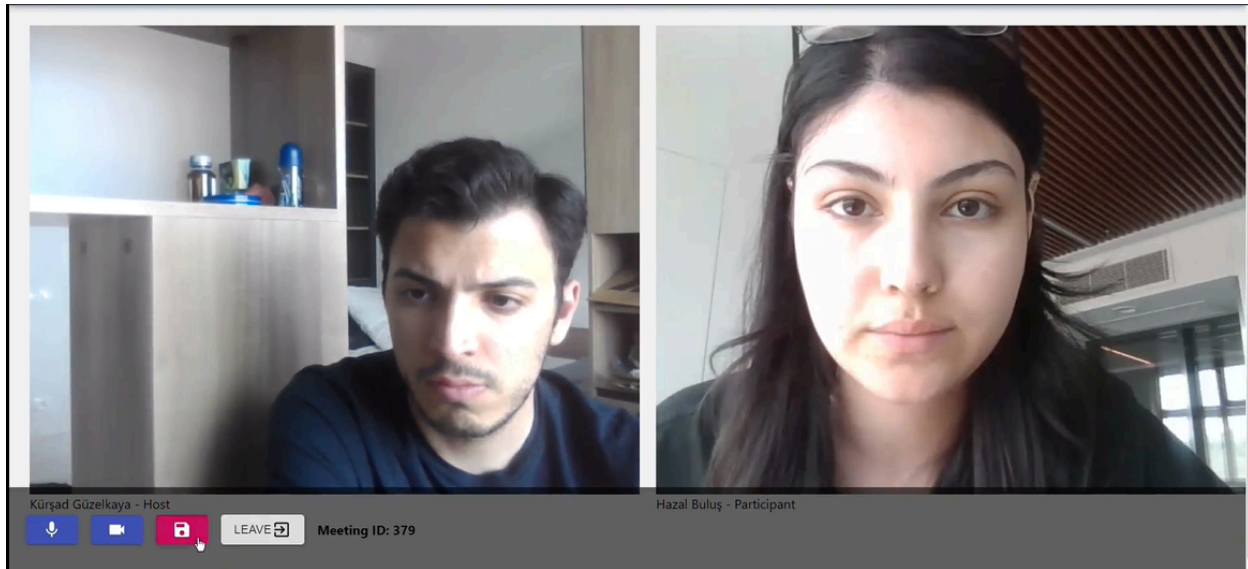


Figure 8: SummarEyes 'Meeting Screen'

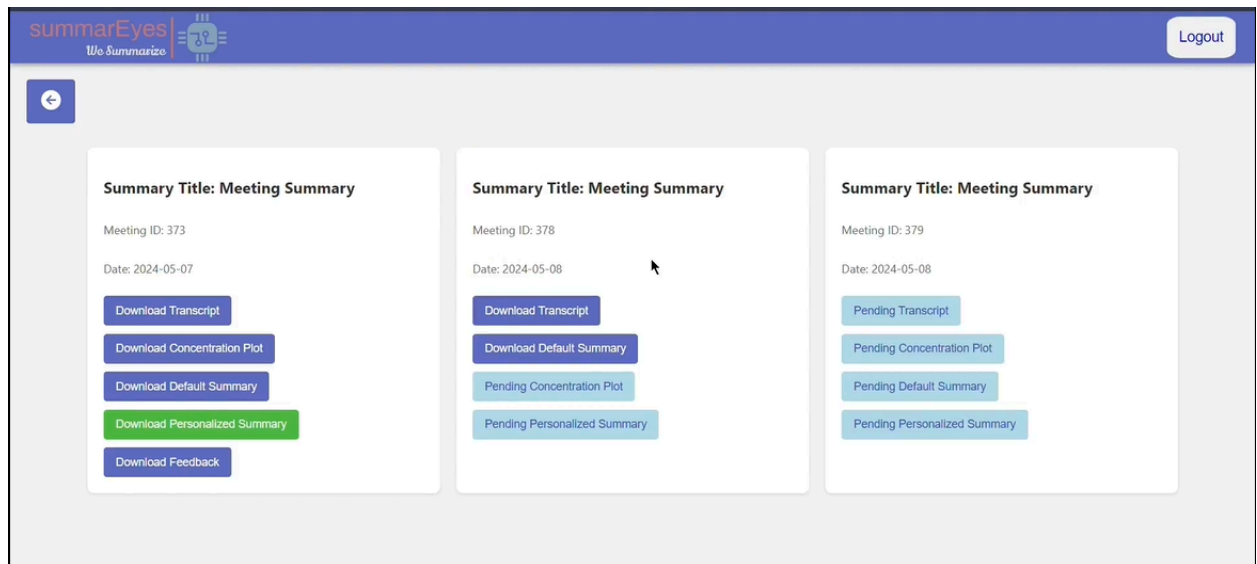


Figure 9: SummarEyes 'Summaries Page'

## 4.2 Backend Implementation

For backend implementation we used Django which is known for its easy usage. With the help of Django's serializer classes, we were able to process the data coming from the client part of the project in the format that we desire. To make the data passing process easier between the backend and frontend side of the application during implementation, we used Postman to add every single url created in the backend with the request it should receive as well as the response it will provide. In this way client-side members gained a considerable amount of time understanding how each method created in the backend works.

To store the data we received from the client side and processed in the backend, we use PostgreSQL. PostgreSQL is highly beneficial to handle large amounts of data transactions, storing various types of entities and with its ease of use, it decreases the complexity of backend development [2]. To deploy our database, we used Render Database to ensure all team members worked on the same database. With features like auto-deploys from Git and zero downtime deployments, Render helped us to create a maintaining and reliable application.

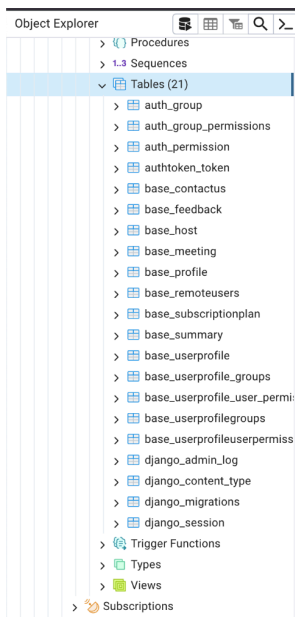


Figure 10: Database Tables

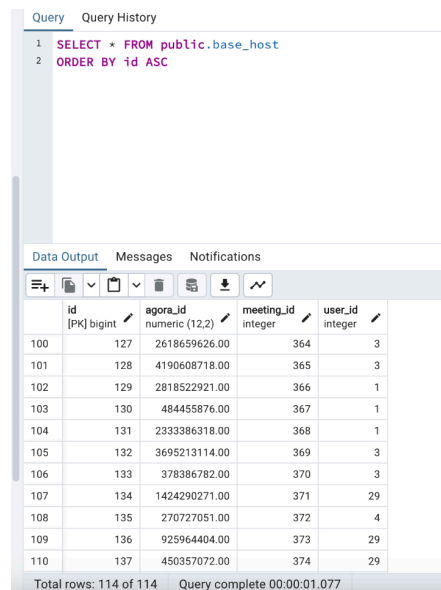


Figure 11: Example of the table Host

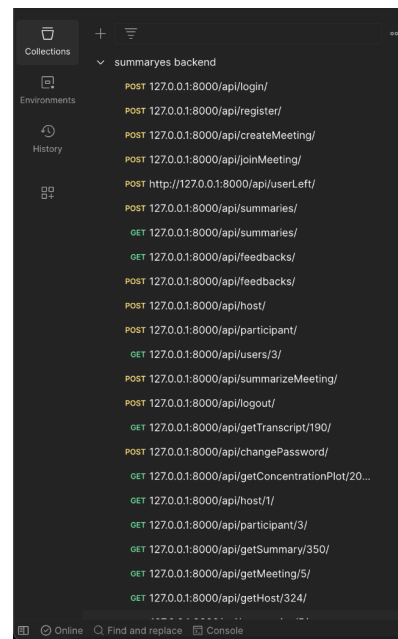


Figure 12: Postman collection

## 4.3 Machine Learning Implementation

### 4.3.1 Concentration Analysis with Eye Detection & Emotion Detection

For concentration analysis, we used eye detection and emotion detection. To accomplish emotion detection, we used Python's FER library. We used a concentration score architecture from the paper "Student Engagement Detection Using Emotion

Analysis, Eye Tracking, and Head Movement with Machine Learning.” [3]

Dominant Emotion	Emotion Weight
Neutral	0.9
Happy	0.6
Surprised	0.6
Sad	0.3
Disgust	0.2
Anger	0.25
Scared	0.3

*Table 1 Emotion Scores [3]*

Table 1 represents Dominant Emotions and their corresponding weights. The resulting Concentration Index (CI) is determined by multiplying the Dominant Emotion Probability (DEP) value by the corresponding Emotion Weight (EW), according to Table 1, expressed by equation 1:  $CI = DEP \times EW$ . According to the paper, if the concentration index is higher than 0.5, then the user is focused, otherwise the user is distracted. To accomplish eye/gaze tracking, we used an open-source library, which results in the user being distracted if more than 10 seconds he/she is not looking at the screen.

#### **4.3.2 Transcription with Speech-to-Text**

We used OpenAI’s transcription model Whisper AI to convert speech to text. The Whisper AI technology provides accurate transcription services, enabling the conversion of speech from various sources into readable text. This capability is crucial for applications requiring documentation of verbal communications or for further processing in other language-based models. The resulting transcript will be given to the language model to summarize.

#### **4.3.3 Summary with Language Model**

We are summarizing content using the advanced language model GPT 3.5 from OpenAI. By inputting text, the models generate concise summaries that capture the main points of the input content. This process is vital for condensing large amounts of information into digestible summaries, making it easier for users to quickly grasp essential information without processing the entire text.

## 5. Test Cases and Results

### 5.1 Functional Test Cases

Test ID	LR1	Category	Functionality	Severity	Critical
Objective	Validate that users can successfully log in with valid credentials.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid login credentials.</li> <li>3. Click the 'Login' button.</li> </ol>				
Expected	User is redirected to the Dashboard Page.				
Date-Result	05.03.2024 - Pass				

Test ID	LR2	Category	Functionality	Severity	Critical
Objective	Ensure that the system denies access with invalid login credentials.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter invalid login credentials.</li> <li>3. Click the 'Login' button.</li> </ol>				
Expected	User receives an error message and remains on the login page.				
Date-Result	05.03.2024 - Pass				

Test ID	LR3	Category	Usability	Severity	Medium
Objective	Validate the registration process for new users.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Click on 'Don't have an account? Sign Up'.</li> <li>3. Fill in the required registration details and submit.</li> </ol>				
Expected	User is successfully registered and redirected to the login page or dashboard.				
Date-Result	05.03.2024 - Pass				

Test ID	LR4	Category	Functionality	Severity	High
Objective	Ensure that the password reset functionality works correctly.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Click on the 'Forgot Password' link.</li> <li>3. Enter the registered email address and submit.</li> </ol>				

	4. Check the email for a reset link and use it to set a new password.
Expected	User can reset their password and log in with the new one.
Date-Result	05.03.2024 - Pass

Test ID	LR5	Category	Usability	Severity	High
Objective	Validate that a new user cannot register with existing credentials.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Click on 'Don't have an account? Sign Up'.</li> <li>3. Fill in the required registration details and submit.</li> </ol>				
Expected	User gets an error message that the user exists.				
Date-Result	05.03.2024 - Pass				

Test ID	LR6	Category	Usability	Severity	Medium
Objective	Ensure that the password is at least 6 characters.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Click on 'Don't have an account? Sign Up'.</li> <li>3. Fill in the required registration details and submit.</li> </ol>				
Expected	User gets an error message that the password cannot be less than 6 characters.				
Date-Result	05.03.2024 - Pass				

Test ID	LR7	Category	Functionality	Severity	Medium
Objective	Verifying new email address.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Click on 'Don't have an account? Sign Up'.</li> <li>3. Fill in the required registration details and submit.</li> <li>4. Verify the email address through the confirmation link sent to the provided email.</li> </ol>				
Expected	User receives a confirmation email and is able to verify their email address successfully, gaining full access to the site's features.				
Date-Result	05.03.2024 - Pass				

Test ID	MS1	Category	Functionality	Severity	Critical
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Objective	Validate that a user can create a new meeting.
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click the 'Create Meeting' button.</li> </ol>
Expected	User is directed to the Meeting Page with a new meeting session created.
Date-Result	21.03.2024 - Pass

Test ID	MS2	Category	Functionality	Severity	High
Objective	Ensure participants can join the meeting using the meeting ID.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Join Meeting' and enter a valid meeting ID.</li> </ol>				
Expected	User joins the specified meeting session.				
Date-Result	21.03.2024 - Pass				

Test ID	MS4	Category	Usability	Severity	Medium
Objective	Verify that meeting participants can mute and unmute their microphones.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Join an ongoing meeting.</li> <li>5. Click the 'Mute' button.</li> <li>6. Click the 'Unmute' button.</li> </ol>				
Expected	User's microphone status toggles between muted and unmuted accordingly.				
Date-Result	21.03.2024 - Pass				

Test ID	MS5	Category	Usability	Severity	Medium
Objective	Ensure the host can end the meeting for everyone.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Create Meeting'.</li> <li>5. Click the 'End Meeting for All' button.</li> </ol>				

Expected	The meeting ends for all participants, and they are redirected or notified.
Date-Result	21.03.2024 - Pass

Test ID	MS6	Category	Usability	Severity	Medium
Objective	Ensure the meeting interface is user-friendly and intuitive.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Join Meeting' and join a meeting.</li> <li>5. Navigate through various meeting controls and features.</li> </ol>				
Expected	All controls are accessible and easy to use.				
Date-Result	21.03.2024 - Pass				

Test ID	MS7	Category	Functionality	Severity	High
Objective	Ensure that participants can turn their video on/off.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Join Meeting' and join a meeting.</li> <li>5. Click the 'Turn Video Off' and 'Turn Video On' buttons.</li> </ol>				
Expected	Video toggles on and off as per the user's actions.				
Date-Result	21.03.2024 - Pass				

Test ID	MS8	Category	Functionality	Severity	High
Objective	Ensure that users can end their participation in a meeting without affecting others.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Join Meeting' and join a meeting.</li> <li>5. Leave the meeting using the 'Leave Meeting' option.</li> </ol>				
Expected	The user exits the meeting while it continues for others.				
Date-Result	21.03.2024 - Pass				



Test ID	MS9	Category	Functionality	Severity	High
Objective	Ensure that when the host ends the meeting for everyone, the meeting token becomes invalid.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Create Meeting'.</li> <li>5. Click the 'End Meeting for All' button.</li> <li>6. Click 'Join Meeting' and enter the meeting id.</li> </ol>				
Expected	User cannot re-enter the meeting as it doesn't exist.				
Date-Result	21.03.2024 - Pass				

Test ID	DBO1	Category	Usability	Severity	Medium
Objective	Verify that users can navigate to different sections from the Dashboard.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click on different sections like Profile, Settings, etc.</li> </ol>				
Expected	Each section loads successfully without errors.				
Date-Result	16.03.2024 - Pass				

Test ID	PR1	Category	Functionality	Severity	Medium
Objective	Verify that user profiles display accurate information.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Profile Page.</li> </ol>				
Expected	User should view their own credentials.				
Date-Result	16.03.2024 - Pass				

Test ID	ST1	Category	Functionality	Severity	Medium
Objective	Ensure users can update their profile information.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Settings Page.</li> </ol>				

	4. Update various fields like name, email, etc., and save changes.
Expected	Changes are saved and reflected immediately.
Date-Result	16.03.2024 - Pass

Test ID	OR1	Category	Functionality	Severity	High
Objective	Verify that organization owners can add members.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. As an owner, navigate to the My Organization page.</li> <li>4. Add a new member by entering their credentials.</li> </ol>				
Expected	The new member is added successfully to the organization.				
Date-Result	16.03.2024 - Pass				

Test ID	OR2	Category	Functionality	Severity	High
Objective	Ensure organizations can change their subscription plan.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Subscriptions Plan Page.</li> <li>4. Select a different plan and complete the necessary steps to change it.</li> </ol>				
Expected	The new subscription plan is activated for the user.				
Date-Result	16.03.2024 - Pass				

Test ID	DAT1	Category	Functionality	Severity	High
Objective	Ensure that all sensitive data stored in the database is encrypted.				
Steps	<ol style="list-style-type: none"> <li>1. Access the server where SummarEyes database is hosted.</li> <li>2. Extract a sample of the data stored.</li> <li>3. Analyze the extracted data to check for encryption.</li> </ol>				
Expected	All sensitive data extracted should be encrypted, demonstrating that the system's persistent data management adheres to encryption standards for data at rest.				
Date-Result	01.04.2024 - Pass				

Test ID	SES1	Category	Functionality	Severity	Medium
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Objective	Verify that the system automatically logs out users after a period of inactivity, enhancing security.
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Remain inactive for the duration specified in the system's security policy (time not yet determined).</li> <li>4. Attempt to perform an action without re-authenticating.</li> </ol>
Expected	The system should automatically log the user out after the specified period of inactivity, requiring re-authentication to continue, thereby validating the session management security.
Date-Result	16.03.2024 - Pass

Test ID	VR1	Category	Functionality	Severity	Medium
Objective	Meeting attendants shouldn't be able to record.				
Steps	<ol style="list-style-type: none"> <li>1. Open SummarEyes webpage</li> <li>2. Login to SummarEyes</li> <li>3. Click the Join Meeting button</li> <li>4. Enter a meeting ID and join a meeting</li> </ol>				
Expected	The Recording button does not exist				
Date-Result	16.03.2024 - Pass				

Test ID	VR2	Category	Functionality	Severity	High
Objective	The meeting host should be able to start recording.				
Steps	<ol style="list-style-type: none"> <li>1. Open SummarEyes webpage</li> <li>2. Login to SummarEyes</li> <li>3. Click the Create Meeting button</li> <li>4. Click the Start Recording button</li> </ol>				
Expected	The recording started pop-up appeared.				
Date-Result	16.03.2024 - Pass				

Test ID	VR3	Category	Functionality	Severity	High
Objective	The consent of the meeting attendant needs to be taken after the host starts recording.				
Steps	<ol style="list-style-type: none"> <li>1. Open SummarEyes webpage</li> <li>2. Login to SummarEyes</li> </ol>				

	3. Click the Join Meeting button 4. The host started recording
Expected	The recording consent pop-up appeared and if the attendant does not accept, his/her video will not be recorded.
Date-Result	16.03.2024 - Pass

Test ID	VR4	Category	Functionality	Severity	High
Objective	The meeting record should be saved to the cloud when the recording ends by the host.				
Steps	<ol style="list-style-type: none"> <li>1. Open SummarEyes webpage</li> <li>2. Login to SummarEyes</li> <li>3. Click the Create Meeting button</li> <li>4. Click the Start Recording button</li> <li>5. Click the End Recording button</li> </ol>				
Expected	The host is informed with a pop-up about recording saved to the cloud, and meeting summaries will be sent to users. The audio and video recordings should be saved to the cloud.				
Date-Result	16.03.2024 - Pass				

Test ID	VR5	Category	Functionality	Severity	Medium
Objective	The meeting record should be saved to the cloud when the meeting ends without ending the recording.				
Steps	<ol style="list-style-type: none"> <li>1. Open SummarEyes webpage</li> <li>2. Login to SummarEyes</li> <li>3. Click the Create Meeting button</li> <li>4. Click the Start Recording button</li> <li>5. Click the End Meeting button</li> </ol>				
Expected	The host is informed with a pop-up about recording saved to the cloud, and meeting summaries will be sent to users. The audio and video recordings should be saved to the cloud.				
Date-Result	16.03.2024 - Pass				

Test ID	SUM1	Category	Functionality	Severity	Critical
Objective	Validate that the Language Model accurately generates summaries from the transcript of the meeting.				
Steps	1. Input a recorded segment of the host's meeting.				

	2. Command the Language Model to generate a summary of the provided segment.
Expected	The AI tool successfully creates a summary that captures the key points of the presentation segment accurately and concisely.
Date-Result	16.03.2024 - Pass

## 5.2 Non-Functional Test Cases

Test ID	MS3	Category	Security	Severity	Critical
Objective	Confirm that a user cannot join a meeting without the correct meeting ID.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Join Meeting' and enter an incorrect or non-existent meeting ID.</li> </ol>				
Expected	User receives an error and cannot join the meeting.				
Date-Result	19.03.2024 - Pass				

Test ID	FB1	Category	Usability	Severity	High
Objective	Ensure that the feedback provided to the host is relevant and constructive regarding their presentation's engagement levels.				
Steps	<ol style="list-style-type: none"> <li>1. Collate the attention and emotion data from a sample video conference.</li> <li>2. Utilize the Language Model to generate feedback for the host based on the collated data.</li> </ol>				
Expected	The Language Model produces feedback that is relevant to the specific segments where engagement dropped and offers constructive suggestions for improvement.				
Date-Result	22.04.2024 - Pass				

Test ID	ET1	Category	Accuracy	Severity	Medium
Objective	Assess the precision of the eye-tracking feature to accurately determine whether guests are looking at the screen or not during the presentation.				
Steps	<ol style="list-style-type: none"> <li>1. Play a video recording to the test subjects while recording their eye movements.</li> <li>2. Analyze the recorded data using the eye-tracking feature to determine focus points.</li> </ol>				

Expected	The eye-tracking feature accurately reflects the test subjects' points of focus in comparison to control data.
Date-Result	22.04.2024 - Pass

Test ID	ET2	Category	Accuracy	Severity	Low
Objective	Test the eye-tracking feature's accuracy in low-light conditions to simulate different user environments.				
Steps	<ol style="list-style-type: none"> <li>1. Set up a test environment with low-light conditions.</li> <li>2. Perform eye-tracking calibration and tracking on subjects within this environment.</li> <li>3. Compare the tracking data with a control set collected in standard lighting conditions.</li> </ol>				
Expected	The eye-tracking feature maintains a high level of accuracy, comparable to the control set, even in low-light conditions.				
Date-Result	22.04.2024 - Pass				

Test ID	FB2	Category	Usability	Severity	Low
Objective	Ensure that the feedback provided to the host is presented in a user-friendly manner, allowing for easy interpretation and action.				
Steps	<ol style="list-style-type: none"> <li>1. Generate feedback using the Language Model based on a set of sample emotion and attention data.</li> <li>2. Review the feedback to assess clarity, actionability, and presentation quality.</li> </ol>				
Expected	The feedback should be clearly structured, easy to understand, and presented in a format that is actionable for the host to make improvements.				
Date-Result	22.04.2024 - Pass				

Test ID	LR8	Category	Security	Severity	High
Objective	Check the system's response to a SQL injection attempt during login.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter credentials with SQL injection code.</li> <li>3. Click the 'Login' button.</li> </ol>				
Expected	System prevents login and may log the attempt for security monitoring.				
Date-Result	10.03.2024 - Pass				

Test ID	LR9	Category	Performance	Severity	Medium
Objective	Assess the response time of the login process.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and click 'Login'.</li> </ol>				
Expected	The login process completes within an acceptable time frame.				
Date-Result	10.03.2024 - Pass				

Test ID	MS10	Category	Performance	Severity	Medium
Objective	Assess the video and audio quality during a meeting.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Join Meeting' and join a meeting.</li> <li>5. Observe the video and audio quality.</li> </ol>				
Expected	Both video and audio are of good quality without significant lag or distortion.				
Date-Result	22.04.2024 - Pass				

Test ID	MS11	Category	Performance	Severity	Medium
Objective	Evaluate the system's handling of large meetings with many participants.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Create Meeting' and host a meeting with a large number of participants.</li> <li>5. Monitor system performance and user experience.</li> </ol>				
Expected	The system remains stable and provides a good user experience, even with many participants.				
Date-Result	22.04.2024 - Pass				

Test ID	MS12	Category	Security/ Usability	Severity	High
Objective	Ensure user consent is obtained before video recording in a meeting.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> </ol>				

	<ol style="list-style-type: none"> <li>3. Navigate to the Dashboard Page.</li> <li>4. Click 'Join Meeting'.</li> <li>5. When the host attempts to start recording, a consent prompt should appear for all participants.</li> <li>6. Participants choose to give or deny consent for recording.</li> </ol>
Expected	No video recording of a participant should commence without their explicit consent. If a participant denies consent, their video should not be recorded and they won't receive a summary of the meeting, ensuring compliance with privacy and data protection standards.
Date-Result	01.05.2024 - Pass

Test ID	SES2	Category	Security/ Usability	Severity	High
Objective	Verify that the system uses cookies appropriately to manage user sessions and that these cookies are secure.				
Steps	<ol style="list-style-type: none"> <li>1. Navigate to the SummarEyes login page.</li> <li>2. Enter valid credentials and login.</li> <li>3. Check the browser's developer tools to view the cookies set by the system.</li> <li>4. Verify that a session cookie is created and is secure.</li> </ol>				
Expected	The system sets a secure session cookie upon login, which is used for managing user sessions without exposing the session ID or sensitive information.				
Date-Result	21.03.2024 - Pass				

Test ID	DAT2	Category	Security	Severity	High
Objective	Confirm that data transmitted between the client and server is encrypted and secure.				
Steps	<ol style="list-style-type: none"> <li>1. Initiate a session and perform a task that involves data transmission.</li> <li>2. Capture the network traffic using a network monitoring tool.</li> <li>3. Analyze the captured data for encryption.</li> </ol>				
Expected	The network traffic analysis should show that the data transmitted is encrypted, indicating that the system uses secure protocols (like HTTPS) for data in transit.				
Date-Result	01.05.2024 - Pass				

Test ID	EA1	Category	Performance	Severity	High
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Objective	Check if the Emotion Analysis script can detect low concentration correctly with one user in the meeting with the host.
Steps	<ol style="list-style-type: none"> <li>1. Save a video recording from the SummarEyes web page with one user</li> <li>2. Get the video of the user from the cloud</li> <li>2. Apply emotional analysis script</li> </ol>
Expected	The script should detect minutes that the user has a low concentration correctly
Date-Result	22.04.2024 - Pass

Test ID	EA2	Category	Performance	Severity	Low
Objective	Check if the Emotion Analysis script can detect low concentration correctly in the low-light condition with one user in the meeting with the host.				
Steps	<ol style="list-style-type: none"> <li>1. Save a low-light condition video recording from the SummarEyes web page with one user</li> <li>2. Get the video of the user from the cloud</li> <li>2. Apply emotional analysis script</li> </ol>				
Expected	The script should detect minutes that the user has a low concentration correctly				
Date-Result	22.04.2024 - Pass				

Test ID	EA3	Category	Performance	Severity	High
Objective	Check if the Emotion Analysis script can detect low concentration correctly with more than one user in the meeting with the host.				
Steps	<ol style="list-style-type: none"> <li>1. Save a video recording from the SummarEyes web page with more than one user</li> <li>2. Get the videos of the users from the cloud</li> <li>3. Apply emotional analysis script to all videos separately</li> </ol>				
Expected	The script should correctly detect the minutes in which the users have a low concentration for each user.				
Date-Result	22.04.2024 - Pass				

Test ID	AS1	Category	Security	Severity	Critical
Objective	The application redirects the user to the login screen when the URL is copied and pasted to a different browser.				
Steps	1. Copy the URL when logged in and paste it to a different browser or				

	window.
Expected	When logged in, copying and pasting the URL to a different browser or window should redirect the user to the login screen.
Date-Result	21.03.2024 - Pass

Test ID	GT6	Category	Security	Severity	High
Objective	The video recordings of the meeting participants shouldn't be stored for any purpose after the job is done.				
Steps	1. Check the database whether there is any table storing users' video recordings.				
Expected	The video recordings of participants are not present in the database. Instead, the required processing is done directly on the upcoming data without keeping them permanently.				
Date-Result	28.04.2024 - Pass				

Test ID	HB1	Category	Usability	Severity	Medium
Objective	Whisper AI should filter out background noise and focus on speech during transcription.				
Steps	1. Play an audio clip with background noise present. 2. Verify that the AI tool prioritizes speech over background noise in the transcription.				
Expected	The Whisper AI accurately transcribes speech while minimizing the impact of background noise.				
Date-Result	22.04.2024 - Pass				

Test ID	HB2	Category	Performance	Severity	High
Objective	Evaluate the Whisper AI's performance when processing and transcribing meetings of varying lengths and complexities.				
Steps	1. Provide the Whisper AI with audio clips of meetings with different durations and with varying levels of complexity. 2. Measure the tool's performance in terms of transcription accuracy, across different complexity levels and processing speed for each clip.				
Expected	The Whisper AI's performance may vary depending on factors such as speech length and complexity. It should demonstrate flexibility in handling				

	these variations while maintaining acceptable levels of accuracy and efficiency.
Date-Result	22.04.2024 - Pass

Test ID	HB3	Category	Usability	Severity	High
Objective	Validate that the AI tool accurately transcribes English speech into text.				
Steps	1. Provide the AI tool with an audio clip containing English speech. 2. Verify that the transcription accurately reflects the English language.				
Expected	The Whisper AI successfully transcribes English speech into text without significant errors.				
Date-Result	22.04.2024 - Pass				

Test ID	HB4	Category	Usability	Severity	Medium
Objective	Validate that the AI tool accurately transcribes Turkish speech into text.				
Steps	1. Provide the AI tool with an audio clip containing Turkish speech. 2. Verify that the transcription accurately reflects the Turkish language.				
Expected	The Whisper AI successfully transcribes Turkish speech into text without significant errors.				
Date-Result	22.04.2024 - Pass				

Test ID	HB5	Category	Usability	Severity	High
Objective	The accuracy rate of the transcript extracted from a meeting should be within the acceptable range.				
Steps	1. Generate the transcript from the meeting recording using the SummarEyes system. 2. Calculate the accuracy rate by identifying and dividing the number of correct words by the total words. 3. Confirm the accuracy rate meets the acceptable threshold.				
Expected	The transcript extracted from what is spoken in a meeting using artificial intelligence tool Whisper AI should be consistent and coherent with what the speaker actually said.				
Date-Result	22.04.2024 - Pass				

## **6. Maintenance Plan and Details**

SummarEyes is built on an advanced technology stack which includes Django web framework for backend development, React library for frontend development, and PostgreSQL for database management, hosted on Render. For data management and storage options additional services like Google Drive, Amazon S3, and Cloud used for their reliable products. In order to maintain the system's functionality, dependability, and security, we intend to establish an extensive maintenance plan.

Regular software upgrades and security patches are planned to be part of our maintenance efforts. In this way, we aim to resolve vulnerabilities, correct defects, and secure compatibility with the newest technology. Our databases will be automatically backed up every day and securely saved on Render as well as Amazon S3 to offer redundancy and speed up recovery in the event of data loss. There will also be additional checks to maximize system performance and proactively handle bugs by checking system logs and performance data.

Our strategic goal is to maintain SummarEyes' competitiveness and adaptability to shifting market demands and technological advancements. This entails incorporating developments in artificial intelligence and machine learning to improve our services, such engagement analysis and transcription, and modifying system resources to maintain scalability when user demand rises. We'll be collecting and analyzing user input on a regular basis to make sure the platform is updated and matches our users' changing demands. An emphasis on economic sustainability will also be included, with regular evaluations of our pricing strategies and operational expenses to strike a balance between service quality and financial viability.

SummarEyes strives to offer a safe, dependable, and efficient platform that satisfies user expectations and changes with the rapidly evolving field of digital communication technologies by keeping an eye on both strategic and operational maintenance and taking a proactive approach to both.

## **7. Other Project Elements**

### **7.1. Consideration of Various Factors in Engineering Design**

#### **7.1.1 Public Health**

Growing worries about "Zoom fatigue," or physical and psychological exhaustion, have arisen from the increased use of virtual meetings. This phenomena, which was thoroughly investigated during the COVID-19 epidemic, emphasizes the mental strain that results from using digital interfaces for extended periods of time as well as the difficulty of deciphering nonverbal signs in a virtual setting [3]. By offering brief meeting summaries based on participant attention and emotion detection, SummarEyes seeks to reduce this stress. This feature enables users to

participate in meetings with less intensity, which may lessen exhaustion. SummarEyes might also include user interface modifications, including the ability to see just the presenter's video, which would simplify the visual field and reduce mental stress.

### **7.1.2 Public Safety**

In the realm of video conferencing, safeguarding sensitive information is paramount. SummarEyes will protect privacy by not keeping meeting recordings on file permanently. Only feedback and summaries will be kept instead, and users will have the option to download and then remove this data. In order to enhance safety even more, hosts will be able to monitor participant interactions, such as adding or removing attendees, in order to preserve meeting integrity and security. Access to meetings will also be restricted through authentication procedures.

### **7.1.3 Public Welfare**

Since SummarEyes is a web program that people will use for personal purpose, there is no impact on public welfare.

### **7.1.4 Global Factors**

While no immediate global factors impact the design of SummarEyes, lessons learned from the COVID-19 pandemic underscore the importance of adaptability in communication tools. Therefore, SummarEyes will be designed with scalability and flexibility in mind, ready to adapt to changing global conditions and emerging user needs.

### **7.1.5 Cultural Factors**

Diversity in communication styles between cultures is an important factor. These differences will be taken into consideration by SummarEyes's mood and attention analysis algorithms. For example, gesture expressiveness differs between communication cultures with high and low context. The model for emotion detection and the dataset for eye tracking will comprise a wide variety of cultural expressions to enable correct analysis and improve the app's cross-cultural usability.

### **7.1.6 Social Factors**

Reducing social biases is an essential part of developing AI. SummarEyes will take extra care to make sure that biases pertaining to age, gender, or race are not present in its attention and emotion analysis algorithms. In order to do this, inclusive datasets will be used, and universal measures of attention and emotion, like eye contact and facial expressions, that are free from bias will be the main focus.

### 7.1.7 Economic Factors

A wide range of users, including companies and academic organizations, are the focus of SummarEyes. The software will be available for free at first to promote user input and wide adoption. Later, tier-based subscription models will be implemented. These models will serve a variety of user needs, including business customers with access to more sophisticated features and support available in premium packages, and educators with easily accessible solutions. This approach seeks to strike a compromise between wide accessibility and financial viability.

Factor	Effect Level	Effect
Public Health	7	Stress during the online meetings should be reduced
Public Safety	8	User's privacy must be secured.
Public Welfare	0	None
Global Factors	2	Scalability and flexibility must be a concern in our development
Cultural Factors	5	Datasets and models should be inclusive
Social Factors	6	No biases should be included
Economic Factors	2	Initially free, then tier-based subscription

*Figure 13: Factor and Effect Table*

## 7.2. Ethics and Professional Responsibilities

In the development of our project, we place utmost importance on ethical practices and professional responsibilities, particularly in relation to user data privacy and compliance with legal standards. Our system makes sure that no personally identifiable information, including images or videos, is kept in order to protect user privacy. We closely adhere to data reduction standards, retaining just the minimum data needed for emotion analysis. This method protects against the misuse of sensitive information by complying with data protection laws and ethical norms.

We're devoted to maintaining openness regarding our data usage guidelines. User data is never shared with outside parties for profit; instead, it is utilized only to improve user experience and service quality. Additionally, we carefully consider licenses that protect privacy and do not require the disclosure of enhancements when using open-source software, so we can maintain user confidentiality. Our procedures are continuously reviewed to make sure they still meet changing user expectations and standards for ethics.

By following these guidelines, we hope to maintain the greatest standards of moral purity and professional accountability, guaranteeing our users' trust and security constantly.

## 7.3. Teamwork Details

### 7.3.1. Contributing and functioning effectively on the team

Throughout the project, all the tasks are distributed as equally as possible among all team members. We divided up the work on our team methodically so that each person could contribute as much as they could.

- Deniz and Burcu took on the task of creating our project's backend logic. Their proficiency with management of databases and server-side components was essential to laying a solid basis for our application.
- Gökhan and Hazal committed their talents to creating the frontend experience in the meantime. Their contributions to the user interface and user experience design were essential to ensuring that our product was both user-friendly and accessible.
- Kürşad and Gökhan managed the ML logic and implemented algorithms that improved the functioning and intelligence of our application thanks to his expertise in machine learning.

Each team member was able to make a substantial contribution to their area of expertise through the assignment allocation, and by working together, they were also able to obtain insights into other project issues.

Furthermore, the strategic use of Jira, WhatsApp, and GitHub, which enabled clear communication, effective work management, and seamless cooperation, greatly increased our team's effectiveness.

- **Zoom & WhatsApp:** We've been using Zoom and WhatsApp for our communications. While we reserve WhatsApp for quick exchanges and urgent matters, Zoom is our go-to for more structured bi-weekly meetings, especially when we can't meet in person. These

platforms have been invaluable for keeping everyone on the same page and fostering collaboration.

- **Jira:** We chose Jira as our project management tool. It's where we keep track of all our tasks and monitor the progress of our project. Jira has been extremely helpful in making sure that everyone knows what they need to do and when they need to do it, which helps in keeping our project on track.
- **Bi-Weekly Meetings:** Instead of meeting weekly, we touch base every one to two weeks. These meetings are key for us to discuss our progress and any challenges we're facing. It's a time for the team to come together and ensure that we're all moving forward together.
- **GitHub:** For version control, we use GitHub. It's been essential for us to work collaboratively on different parts of the project without stepping on each other's toes. It keeps our work organized and makes sure that everyone is contributing effectively.

### 7.3.2. Helping creating a collaborative and inclusive environment

Establishing a cooperative, inclusive workplace where each person's voice was respected was our team's top priority. All team members could exchange ideas, offer criticism, and ask for assistance as necessary thanks to frequent team meetings and open lines of communication. We were able to solve problems more skillfully and come up with new ideas as a team since this strategy promoted a feeling of respect and belonging among the team members. We acknowledged and appreciated the differences in our backgrounds and skill sets, realizing that each person added a special touch to the project and enriched its progress.

### 7.3.3. Taking lead role and sharing leadership on the team

Leadership within our team was fluid and shared, with members stepping up to lead in their areas of expertise while supporting others in their roles. Deniz and Burcu, for instance, not only led the development of the backend logic but also facilitated knowledge sharing sessions on backend technologies for the rest of the team. Similarly, Gökhan and Hazal, besides leading the frontend development, contributed to creating design guidelines that helped unify our project's visual and functional aspects. Kürşad took the initiative to introduce machine learning concepts to the team, enhancing our collective understanding of how AI could be leveraged in our project. This shared leadership model ensured that each member could develop leadership skills and contribute to the project's success in multiple ways.



### **7.3.4. Meeting objectives**

Throughout the development of our online meeting web app, we've made significant strides toward reaching our project goals. The app combines React on the frontend with Django on the backend and incorporates Agora SDK to facilitate online meetings, creating a robust platform.

Our application really shines with its innovative features. We've implemented emotion detection using the Python FER library and added gaze tracking to check if participants are looking at their screens. These features feed into one of our standout functionalities: the ability to detect when participants' attention wanes. By analyzing emotional and gaze data, the app pinpoints moments of decreased concentration and summarizes these segments for individual users. This feedback is then relayed to the meeting host through LangChain and advanced language models, helping to improve meeting engagement and effectiveness.

However, we've noticed some challenges with the app's performance during longer meetings, likely due to our current resource constraints. This issue has been earmarked for future improvements, aiming to enhance the app's stability and user experience during extended use. Despite these hurdles, we've met our primary objectives and are planning for these enhancements in the next development phase.

## **7.4 New Knowledge Acquired and Applied**

During the course of this project, our team has acquired a substantial amount of new knowledge, crucial for building our online meeting web application. We began by diving into React, a versatile JavaScript library that we used to develop the frontend of our application. Working with React helped us improve our skills in creating interactive and user-friendly interfaces, which are essential for engaging users effectively.

At the same time, we explored Django, a high-level Python framework that we chose for our application's backend. Integrating Django with React was a key step for us, providing a strong foundation for handling complex server-side operations and efficient data management. This setup proved to be vital for managing real-time communications seamlessly.

Incorporating the Agora SDK was another major aspect of our learning journey. This SDK was integral to adding real-time video and audio communication functionalities to our app. Mastering its integration and optimization within our framework allowed us to deliver high-quality communication experiences to our users.

We also ventured into new territories with features like emotion detection using the Python FER library and gaze tracking. These features required us to learn about machine learning and

computer vision technologies, enabling us to assess user engagement and provide insights that improved meeting dynamics.

Furthermore, as we encountered performance challenges during longer meetings, we were pushed to learn more about performance optimization and resource management. This part of the project was particularly enlightening, as it taught us about the limitations of our current setup and pointed out opportunities for future enhancements.

Overall, this project was not just about meeting our objectives but also about pushing our boundaries and expanding our technical know-how. It prepared us well for future challenges and more complex projects down the line.

## **8. Conclusion and Future Work**

In conclusion, the SummarEyes project has successfully demonstrated its capability to enhance the video conferencing experience by integrating advanced features such as intelligent meeting summaries, attention analysis, and emotion detection. These innovations address critical challenges in maintaining engagement and effectiveness during remote interactions. Our tests and evaluations have confirmed that SummarEyes meets a high standard of performance, reliability, and usability, making it a valuable tool for various professional and educational settings.

Looking forward, there are several areas where we aim to expand and improve the capabilities of SummarEyes. Firstly, we seek additional funding to tackle the current limitations related to the processing speed of meeting video analysis. The existing system can be slow, especially with a large number of participants, which sometimes leads to delays in generating meeting summaries and feedback. With additional resources, we plan to enhance our computational efficiency to offer real-time analysis, ensuring that insights and summaries are delivered with minimal latency.

Another avenue for future development is the implementation of real-time analysis capabilities. This improvement will allow users to receive immediate feedback on their engagement levels and emotional states, which can significantly improve interaction quality during meetings. Moreover, we are exploring the possibility of adding advanced features such as shared screen properties to further enrich the collaborative experience.

Real-time processing and additional features like screen sharing will not only enhance user experience but also expand the applicability of SummarEyes across more diverse scenarios, such as larger conferences or educational classes where real-time feedback can be particularly beneficial.

Overall, while SummarEyes has proven to be a successful project in its current form, the potential for growth and improvement is substantial. With continued development and the acquisition of additional funding, we can further refine the system to meet the evolving needs of

our users, ensuring that SummarEyes remains at the forefront of digital communication technology.

## 9. Glossary

**RBAC:** Role-Based Access Control - A method to regulate access to computer and network resources based on the roles of users within an organization.

**URL:** Uniform Resource Locator - The address used to access a website.

**HTTP:** Hypertext Transfer Protocol - The foundation of data communication for the World Wide Web (WWW).

**TCP/IP:** Transmission Control Protocol/Internet Protocol - Communication protocols used to interconnect network devices on the internet.

**S3 Bucket:** A storage resource in Amazon S3 (Simple Storage Service) where data can be stored in buckets.

**Heroku Server:** A cloud platform where applications can be deployed.

**API:** Application Programming Interface

**API Gateway:** A service that provides an API endpoint to access microservices and handle request routing.

**SQL:** Structured Query Language - A language where users can store, manipulate and retrieve data in databases.

**AI:** Artificial Intelligence

**ML:** Machine Learning

**UI:** User Interface - The platform that allows human and machine interactions.

**FER:** Facial Expression Recognition - Refers to the technology used to detect and analyze facial expressions from video.

**WebRTC:** Web Real-Time Communication - An open-source project that provides web browsers and mobile applications with real-time communication via simple application programming interfaces (APIs).

**HTTPS:** Hypertext Transfer Protocol Secure - An extension of HTTP. It is used for secure communication over a computer network, and is widely used on the Internet.

**CI:** Concentration Index - A metric used in the project to quantify the level of attention or concentration of meeting participants.

**DEP:** Dominant Emotion Probability - A term used to describe the probability that a specific emotion is dominant during a segment of video analysis.

**EW:** Emotion Weight - A value assigned to different emotions to quantify their impact on the concentration index.

## 10. References

[1] “Three-tier client server architecture in Distributed System,” GeeksforGeeks, 24-Feb-2022. [Online]. Available:

<https://www.geeksforgeeks.org/three-tier-client-server-architecture-in-distributed-system/>.

[Accessed: 11-May-2024].

[2] [1]“What is PostgreSQL? Features and Benefits | Quest,” *Quest Software*.

<https://www.quest.com/learn/what-is-postgresql.aspx>

[3] Sharma, P., Joshi, S., Gautam, S., Maharjan, S., Ram Khana1, S., Reis, M. C., Barroso, J., & Filipe, V. M. de J. (Year). Student Engagement Detection Using Emotion Analysis, Eye Tracking and Head Movement with Machine Learning. University of Massachusetts Boston, Kathmandu University, Wentworth Institute of Technology, Center for Precision and Automated Agricultural Systems, University of Trás-os-Montes e Alto Douro, University of Aveiro, INESC TEC.

<https://arxiv.org/pdf/1909.12913>

[4] “Zoom Fatigue – Why video calls are so exhausting,” *allianzcare.com*. [Online]. Available: <https://www.allianzcare.com/en/about-us/blog/2021/03/zoom-fatigue.html>.

[Accessed: 6-Dec-2023].