

Project Requirements Document, Version 2

Project: Provider Augmentation for Behavioral Health Analysis

Team Name: Interlinked

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Intro

Motivation

Doctors require augmentations/assistance in making accurate behavioral diagnoses, since mental health is complex to analyze. We believe software can enhance doctors' capabilities by providing more information to them. There seems to be a lack of ways for doctors to get extra information about mental health, unlike using lab tests or medical equipment for gathering information on physical health like weight, hormone levels, blood pressure, etc. Additionally, mental health is a fast-growing field that has huge demand and is already over-taxing doctors today, leading many experts to call it the largest epidemic affecting humanity. Any UCSB Student can find this to be true if they were to visit the CAPS office on campus. Appointments sometimes cannot be made for months to see a mental health therapist. Doctors need ways to handle treatment of the growing number of patients, especially since there are so few specialists in the behavioral health sphere. Remote areas also often lack access to mental health services due to high cost, lack of availability, and stigma against mental health treatment. Therefore there needs to be a tool that allows behavioral health specialists to connect to patients remotely to avoid losing time to travel and also provide additional information on the patient that might not be easy to determine in a conversation across a webcam.

Objective

Our objective is to provide that tool that will enhance the diagnostic capabilities of doctors concerning mental health, as well as possibly improving the accessibility of these health services. We are aiming to provide a software tool that streams audio /

video between patient and doctor. The software interface would provide results of sentiment analysis of the patient's facial expressions and speech to the doctor. The company we work with, InTouch Health, is providing machine learning models for performing sentiment analysis, but it is possible for us to work on improving the accuracy / diversity of statistics the models provide. Since we are dealing with sensitive patient information, we will also need to secure the data to an appropriate degree. We will also store relevant data to allow doctors to make use of historical data and analysis. Stretch goals would include enhancements of these features so far discussed, as well as improving the accuracy and modifying the machine learning models that provide sentiment analysis. Adding features or creating models for dealing with nuances in human speech and expressions like sarcasm are also far off possibilities.

Innovation

We are innovating by creating a communication channel and data analysis for the doctor to better work with their patients. We are increasing the ease of interaction between doctor and patient, first of all. Second, we are providing information that is not often gathered for use in behavioral health analysis using sentiment analysis by machine learning models. Our tool provides a way for doctors to get statistics they do not get in person or normally as well as reanalyze previous sessions with patients so that valuable information is not lost.

Technology

We do not expect to require devices more complicated than normal computers with webcams most ideally (that is, no proprietary hardware is expected). We also do not expect this tool to be an extensive tool for data analytics, as it should simply provide information. The information gathered should solely be based off the audio and video provided by the patient. No other physical hardware to gather data like heartbeat or blood pressure would be used. We also assume that data from these sources is suitable enough to assist doctors in treating behavioral health. We assume that doctors want real time and post processing of data. We assume doctors generally should be looking at the sentiment analysis during these sessions, but patients can possibly also be shown the sentiment analysis. Patients should be able to look at some of their own data. We assume that patients can legally agree to all the services that our software should provide.

We have decided on the main technical stack of our application. Our frontend will consist of a React application using Material UI, because they are simple enough to

build applications with and are powerful enough to give us agency over how we design the UI to fit the needs of doctors and patients. Our frontend code will be written in Typescript with React extension. Typescript allows us to use syntax that does not exist in Javascript to perform static analysis. The React extension allows us to write declarative code embedded in normal Javascript code, simplifying UI implementation. This React app will connect to a Golang REST API router designed using the Gin framework. Gin is a lightweight framework designed to create REST endpoints that a React app can connect to and pull information from. This router will perform the computations associated with sentiment modeling and be able to pull data from a database containing patient and provider data. The REST API will connect to a MongoDB database which will store that data. We opted to use a NoSQL database because the interface does not have an emphasis on the relationship between entities, but rather a need to store data flexibly.

Goals

As a team, our main goal is to have a project built from start to finish, from backend to frontend. Along with building a project, we hope to improve every team member's communication skills and learn how to work as a cohesive team. This project requires skills in frontend, backend, and machine learning for sentiment analysis. Provider Augmentation is a project that employs data visualization through getting data using machine learning, so those of us with a machine learning background will understand and perhaps improve the models that we are provided. The challenge we will be facing is designing a user interface that will be intuitive for providers and patients as they use the system, as it is essential to communicate information to providers clearly for critical mental health analysis. We will work on this challenge by working with Intouch Health and having them review our user interfaces, possibly by utilizing real providers and real patients, so that we deliver an application that truly suits the needs of the people we are making it for.

Background

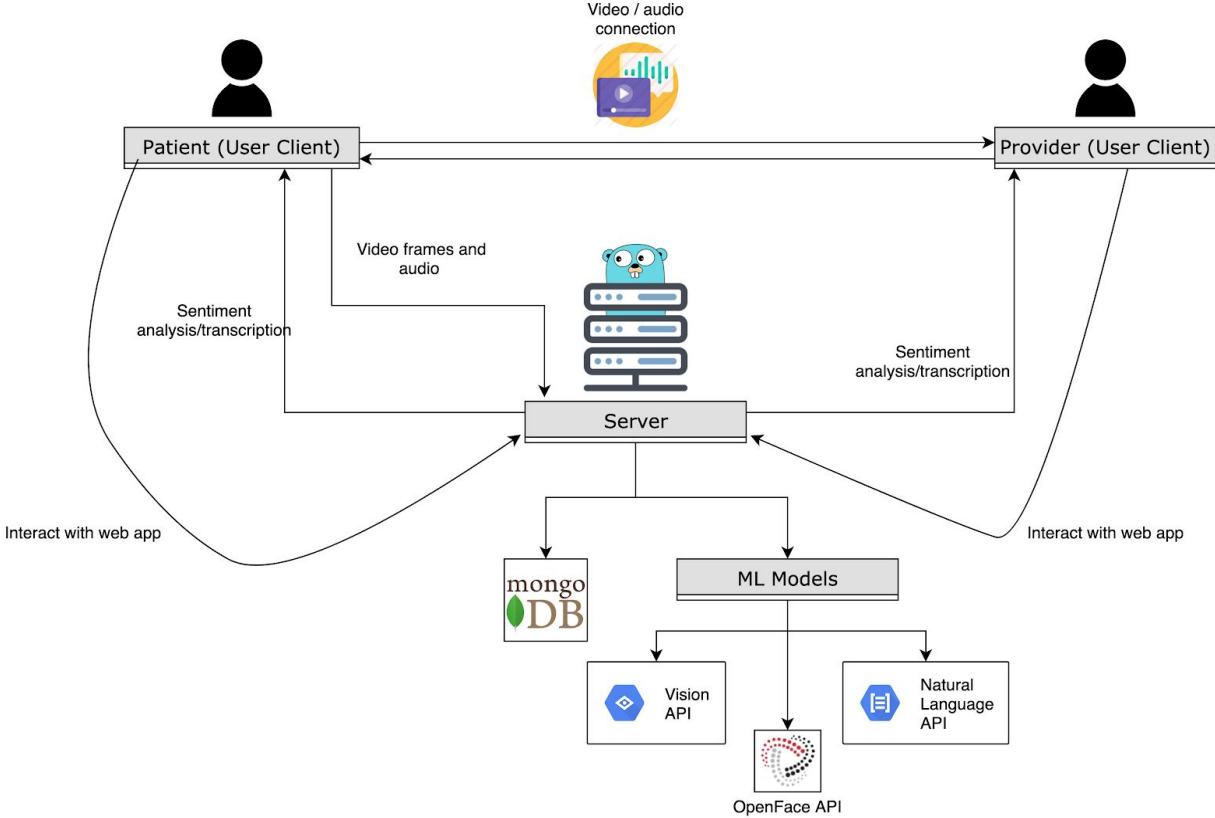
There are not many other apps in competition with the one we are building. Some provide a platform for therapists to manage their notes on sessions with patients, which is a great idea / extension for our app to implement in the far future. Other apps deal with Telehealth (software for remote access to healthcare) by having secure channels for providers and patients to communicate. None of these apps provide real-time facial and speech sentiment analysis that we are looking to build in our project.

Overall though, there is a lot of hype in the facial sentiment analysis applications, it is predicted to be worth more than a 20 billion dollar industry by 2020. These applications range from special tailored advertisements based on how a person is feeling to figuring out whether or not a candidate will be good for a company. Though the innovation in our project will be the quality of our machine learning models providing sentiment analysis in real time, and hopefully in post processing as well. We still want to build similar features such as secure remote communication (maybe notes for providers as well), while enhancing these tools with insights of data analysis.

Conclusion

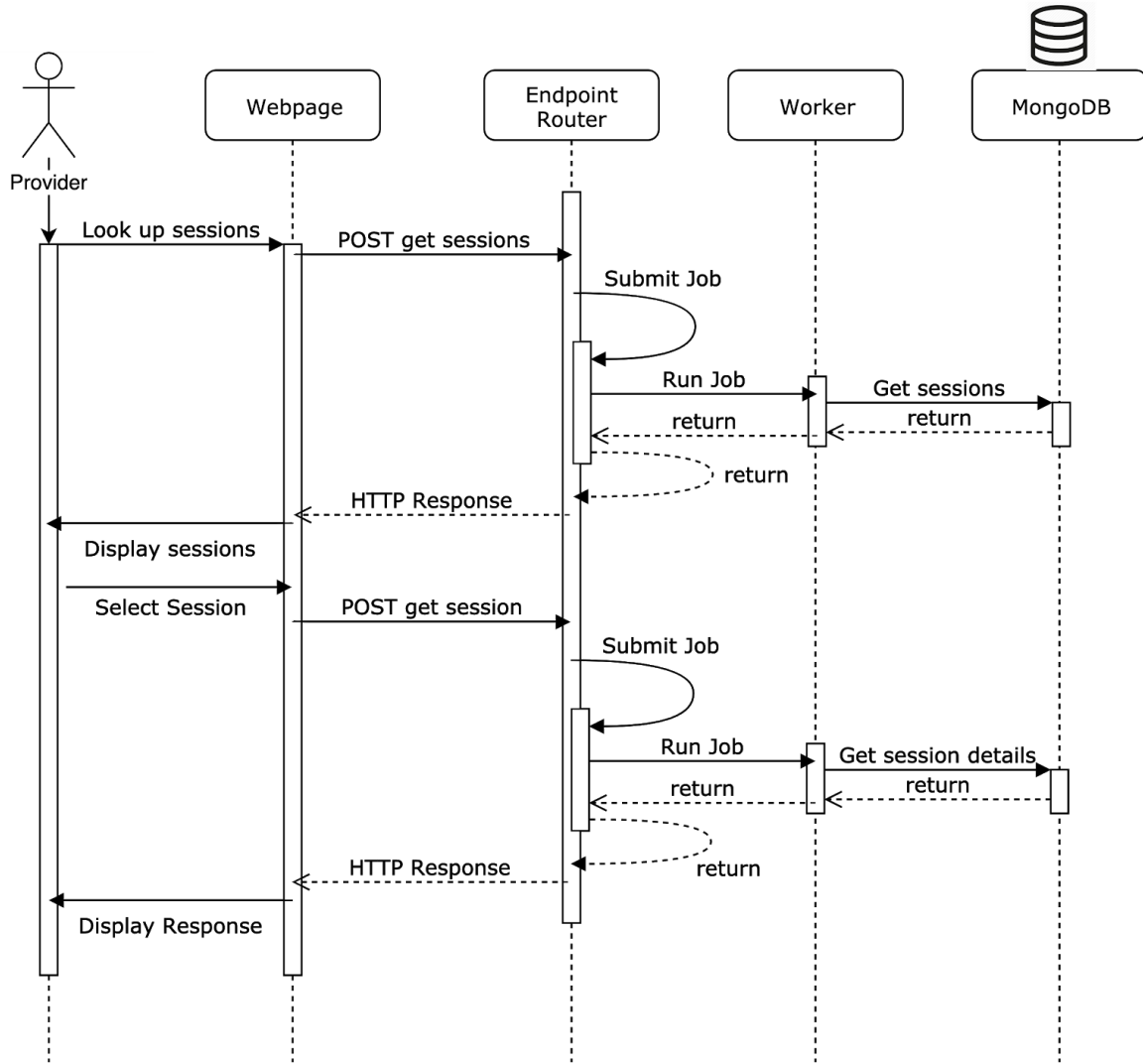
Our team is attempting to build an application to increase the accessibility and power of behavioral health services by creating an interface for doctors and patients to interact, and doctors can use this application to view indicators from a patient that they might never have picked up on otherwise.

System Architecture

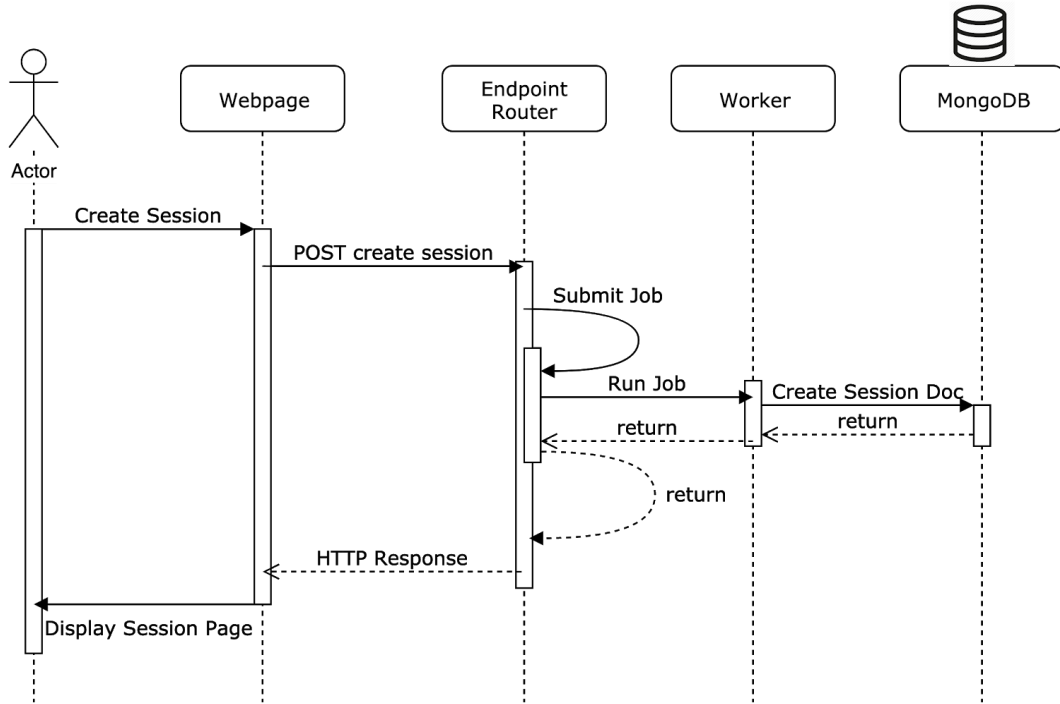


User Interactions

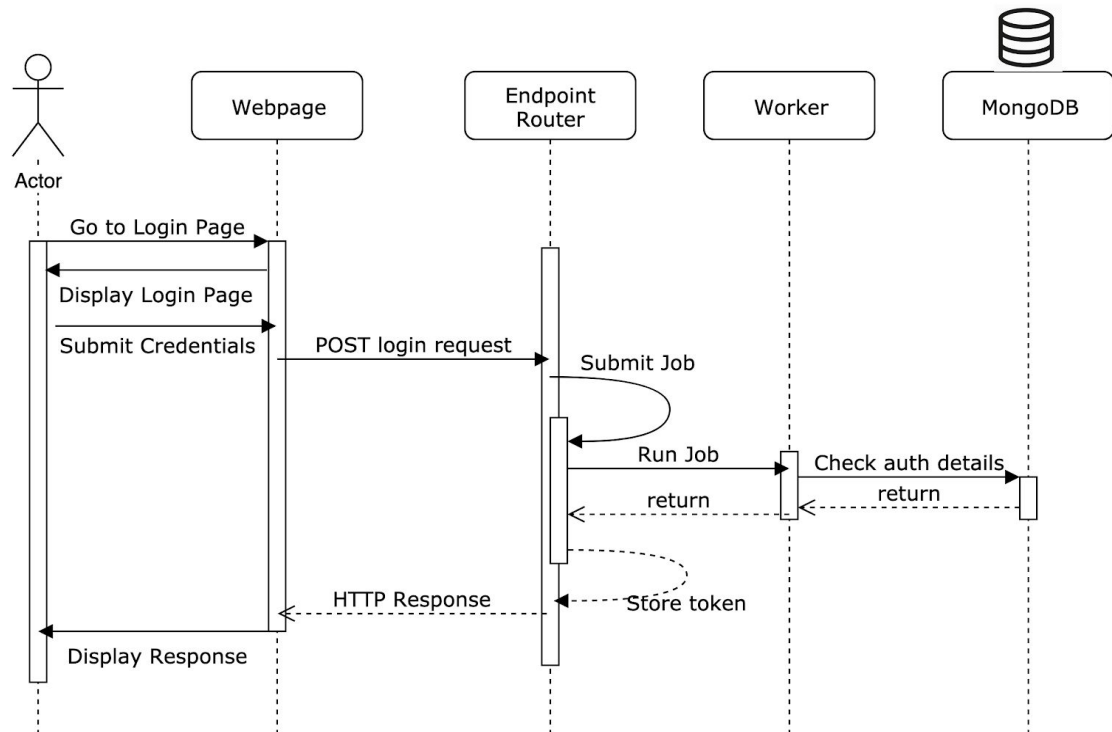
Provider Gets Session Information



User Creates Session

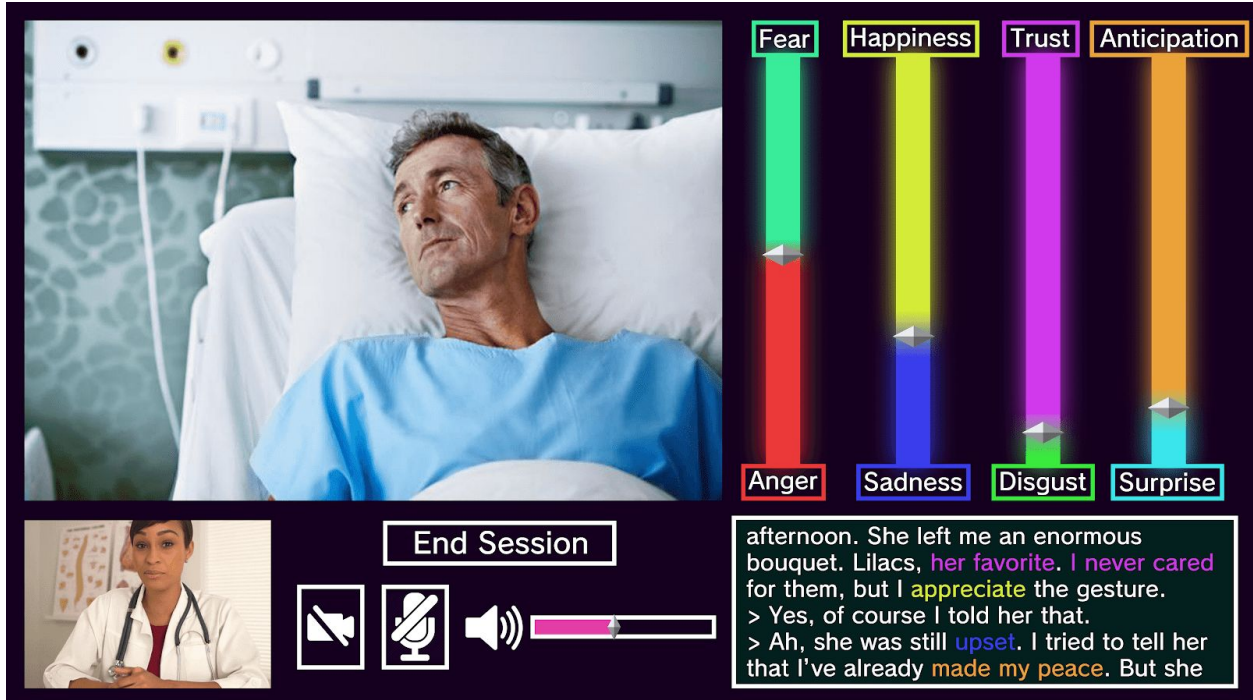


User Logs in

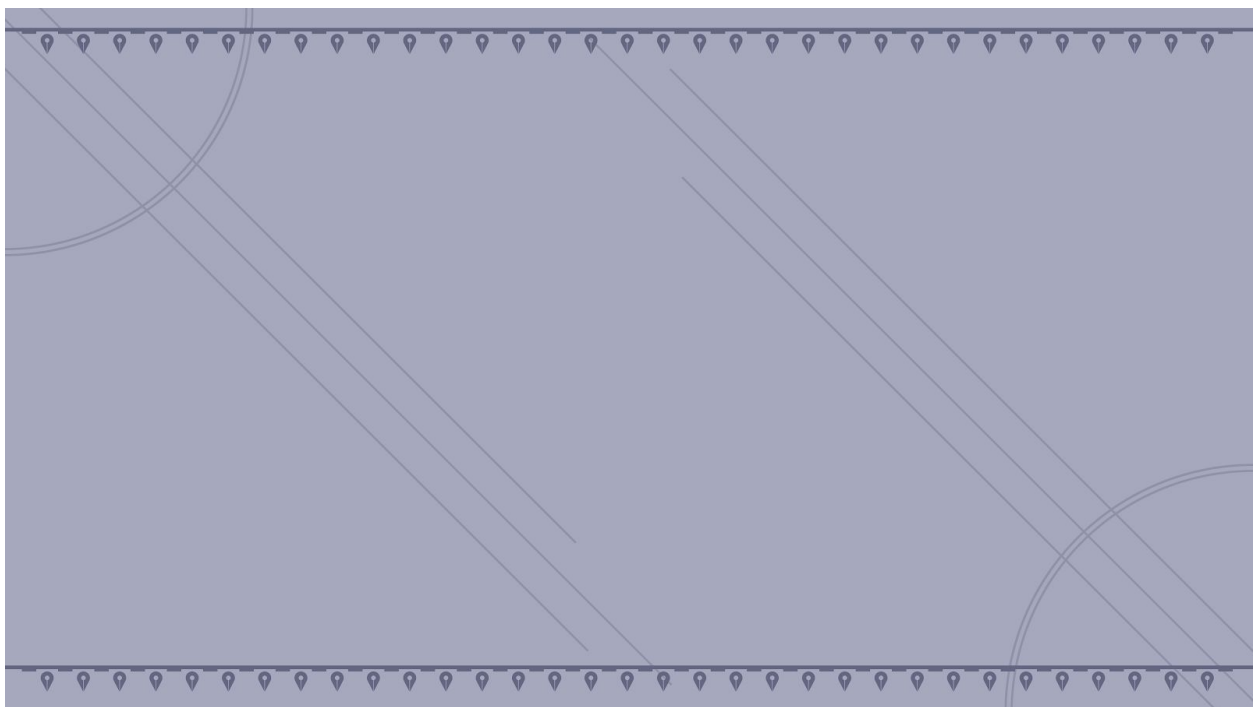


UI Design

Main Interface Mockup



Background (for all other pages) Mockup



Requirements

As a user, I can join a session and see a page with UI so that I can interact with another user.

Estimated time to complete: 3 days (Completed)

Acceptance Criteria: When a user can click a button to be taken to the session interface.

Github links (issues):

<https://github.com/BLimmie/intouch-health-capstone-2019/issues/2>

<https://github.com/BLimmie/intouch-health-capstone-2019/issues/1>

- Scenario 1: Given a user clicks a link to join session without another user
 - When user clicks the link and sees the session page
 - Then they will see a black screen until the other user joins
- Scenario 2: Given a user clicks a link to join session with another user present
 - When user clicks the link and sees the session page
 - Then they will see the other user is in the session and extra information available
- Scenario 3: Given the user is not authorized to join
 - When user clicks the link and tries to join session
 - Then the browser displays a connection refused message

As a user, I can see the other user's video feed, so that I can communicate with them effectively.

Estimated time to complete: 6 days

Acceptance Criteria: Pass manual test for stable video connection.

Github link (issue):

<https://github.com/BLimmie/intouch-health-capstone-2019/issues/3>

- Scenario 1: Video is successfully received
 - Given the patient and the physician are in a session
 - When a user looks at the region of the screen that should have the other user's video feed
 - Then the user will see the other user's video feed
- Scenario 2: Video is not received successfully
 - Given the patient and the physician are in a session
 - When the user looks at the region of the screen that should have the other user's video feed
 - Then the user will see an error image in that region

As a user, I can hear the other user's audio, so that I can communicate with them effectively.

Estimated time to complete: 3 days

Acceptance Criteria: Pass manual test for stable audio connection.

Github link (issue):

<https://github.com/BLimmie/intouch-health-capstone-2019/issues/4>

- Scenario 1: Audio is successfully received
 - Given the patient and the physician are in a session
 - When the user attempts to hear the other user
 - Then the user will hear them

As a user, I can quit a session.

Estimated time to complete: 2 days (Prototype Completed)

Acceptance Criteria: Have UI element for quitting a session. Pass manual testing to ensure that the element works. Have and pass automated unit and integration tests covering cases of user quitting.

Github link (prototype):

<https://github.com/BLimmie/intouch-health-capstone-2019/commit/3ad5bcb149056cb432230b102b4e664a86d5ff5c>

Github link (issue):

<https://github.com/BLimmie/intouch-health-capstone-2019/issues/5>

- Scenario 1: There exists another user in the room once the user leaves
 - Given that a user clicks the quit a session button or exits the page
 - And another user stays on the session
 - When the other user sees the user's video feed
 - Then the other user should see a black screen
 - And be redirected to the home screen
- Scenario 2: No users remain in the room, session is closed
 - Given that both users click the quit a session button or exits the page
 - When the server is notified that both users left
 - Then the session is ended and no user can join that session again

As a physician, I have the option to see the details of my patient's current facial expression.

Estimated time to complete: 5 days

Acceptance Criteria: Have UI element for turning the option on and off. Pass manual testing to ensure that the element works. Have and pass automated unit and integration tests covering cases of toggling the option.

- Scenario 1: The option to see these details is turned off

- Given that the physician and patient are in a session
- And the video can be seen
- When the patient changes expression
- Then the physician's interface will not contain the details of the patient's current facial expression
- Scenario 2: The option to see these details is turned on
 - Given that the physician and patient are in a session
 - And the video can be seen
 - When the patient changes expression
 - Then the physician's interface will contain the details of the patient's current facial expression, such as "eyebrows raised" or eyes squinted"

As a physician, I can see the emotion levels of my patient's face at the moment, so that I can more accurately diagnose my patient.

Estimated time to complete: 5 days

Acceptance Criteria: When a manual test is passed, in which a physician will be able to see the various emotion levels of their patient's facial expression as visualized by a polar area chart.

Github link (prototype):

<https://github.com/BLimmie/intouch-health-capstone-2019/commit/0bbbe82ea9e9f80d79a890e81a4c0dd1f6c62ecb>

Github link (tests):

<https://github.com/BLimmie/intouch-health-capstone-2019/commit/8bb15995924a952a233e4cd49f43abbbcf82b87e>

- Scenario 1: Emotion levels are accurate
 - Given that the physician and patient are in a session
 - And the video can be seen
 - When the patient changes expression
 - Then the physician will be able to see the patient's emotion levels, based on their appearance

As a physician, I can see a transcription of my patient's speech, color coded according to sentiment, so that I can more accurately diagnose my patient.

Estimated time to complete: 10 days (Prototype complete)

Acceptance Criteria: The patient's speech is accurately transcribed and it is correctly color-coded as white, yellow, or blue, depending on whether their phrases are neutral, positive, or negative, tested with predetermined phrases.

Github link (implementation):

<https://github.com/BLimmie/intouch-health-capstone-2019/commit/64f56d1daaae03fb60c81b805882a0f5b84bb711>

Github link (tests):

<https://github.com/BLimmie/intouch-health-capstone-2019/commit/8bb15995924a952a233e4cd49f43abbbcf82b87e>

- Scenario 1: Audio transcription and color-coding are accurate
 - Given that the physician and patient are in a session
 - And the audio can be heard
 - And the patient has said something since the session started
 - When the patient says something
 - Then the physician will be able to see an accurate transcription of what the patient just said, with key words indicating sentiment color-coded according to which emotion they indicate

As a physician, I can create and log into account with the web app, so that I can start or join sessions with my patients (without creating all the requests manually).

Estimated time to complete: 9 days (Prototype Complete)

Acceptance Criteria: A user is able to create an account, with their information stored in a database. They can also log in to this account, and will be presented with the appropriate interface that will allow them to join or create a session.

- Scenario 1: No logged in account, no account.
 - Given that the physician hasn't logged into any account and has no account.
 - When the physician tries to log in.
 - A login interface is shown to the physician. It also shows a portal to where the physician is able to create an account. The physician goes through the portal.
 - And the physician starts to use the account creation interface, insert and submit information.
 - And the physician has an account after inserting valid and complete information. They are then shown the login interface to login again.
 - Same as Scenario 2.
- Scenario 2: No logged in account, has account.
 - Given that the physician hasn't logged into any account but has at least one account.
 - When the physician tries to log in.
 - The physician is shown the login interface.

- Then the physician inputs valid credentials. Server checks the credentials. If credentials good the interface for starting/joining a session is created.
- Same as Scenario 3, skipping validation of credentials just cached.
- Scenario 3: Logged in 1 account.
 - Given that the physician has logged into one account.
 - When the physician tries to log in.
 - An interface allowing the physician to start/join a session is shown.
 - When the physician chooses to start a session, start a session. When they choose to join a session, show an error when there is no session. Join the session when there is one.
 - An interface of an ongoing session is shown.

As a patient, I can create and log into an account, so that I can have sessions with my physicians, along with accessing information on past sessions.

Estimated time to complete: 8 days

Acceptance Criteria: A user is able to create an account, with their information stored in a database. They can also log in to this account, and will be able to access the data collected on their patients during any previous sessions. This information will also be stored in a database.

- Scenario 1: Patient does not have account
 - Given the patient does not already have an account
 - When the patient enters their information and clicks on the “Log In” button
 - Then they will not be able to log in, because they don’t have an account
 - When the patient clicks on the “Create Account” button
 - Then they will be taken to a screen where they can enter their information to create an account
 - And they will be able to log into this account in the future
- Scenario 2: Patient does have account
 - Given the patient already has an account
 - When the patient enters their information and clicks on the “Log In” button
 - Then they will be able to log in to their account
 - And they will be able to join a session with a physician
 - As well as access information on past sessions

As a physician, I can access any and all information (except audio and video) from my past sessions with my patients after logging into my account, so that I can review a patient’s history to assist with diagnoses and future sessions.

Estimated time to complete: 6 days

Acceptance Criteria: After a physician logs in, they will be able to access a transcript of any previous sessions, as well as the data collected on the patient's emotions. At the moment, audio and video would take up too much space to store.

- Scenario 1: Physician requests the data of a patient in the system
 - Given the physician wants the personal data collected on a patient in the system
 - And they are asking for the data of that patient
 - When they request that data
 - Then they get a formatted document of that patient's past sessions and personal information
- Scenario 2: Physician requests the data of a patient not in the system
 - Given the physician wants the personal data collected on a patient not in the system
 - And they are asking for the data of that patient
 - When they request that data
 - Then they will get an error message
- Scenario 3: Physician requests the data of a patient that isn't linked to them
 - Given the physician wants the personal data of a person that is not their patient
 - And they are asking for the data of that patient
 - When they request the data
 - Then they get an error message
 - And not get the data

As a physician, I can request that a patient's account be linked with my account, so I can properly store future sessions as well as retrieve their past sessions and available medical records.

Estimated time to complete: 3 days

Acceptance Criteria: After a physician logs in, they can find a patient's account and click a button to request that their two accounts are linked.

Github link (issue): <https://github.com/BLimmie/intouch-health-capstone-2019/issues/14>

- Scenario 1: Physician and patient accounts are not linked
 - Given the physician and patient accounts exist
 - And they are not already linked
 - When the physician enters a patient's information
 - And clicks the "Link Account" button
 - Then the two accounts will be linked
 - And the physician can properly store future sessions
 - And retrieve the patient's past sessions and available medical records

- Scenario 2: Physician and patient accounts are already linked
 - Given the physician and patient accounts exist
 - And they are already linked
 - When the physician enters a patient's information
 - And clicks the "Link Account" button
 - Then an error message will appear
 - And the two accounts will still be linked
- Scenario 3: Patient account does not exist
 - Given the physician's account exists
 - And the patient's account does not exist
 - When the physician enters a patient's information
 - And clicks the "Link Account" button
 - Then an error message will appear
 - And the physician's account will not be linked to any new accounts

As a provider, I can request a session to be created between me and a linked user given by username so that I can later have a video call with them.

Estimated time to complete: 4 days

Acceptance Criteria: After a physician logs in, they will be able to click on any patient with an account linked to theirs, and schedule a future session. At the specified time, a session will begin, that either involved party may join.

Github link (issue): <https://github.com/BLimmie/intouch-health-capstone-2019/issues/15>

- Scenario 1: Session is unavailable
 - Given certain information a provider wants to input
 - When provider enters that information to create a session
 - And the information is invalid
 - Then an error message will appear
 - And no session will be scheduled
- Scenario 2: Session is available
 - Given certain information a provider wants to input
 - When provider enters that information to create a session
 - And the information is valid
 - Then a success message will appear
 - And a session will be scheduled
 - And the patient will be notified

As a user I can change personal information on my account so that my profile is up to date and is as I want it to appear.

Estimated time to complete: 14 days

Acceptance Criteria: Have a dedicated page for editing the user profile. Pass manual tests of the user profile editing process. Have and pass automated unit and integration tests for components related to the process.

- Scenario 1: New info is invalid
 - Given new information a user wants to update to
 - When user enters that information to update
 - And the information is invalid
 - Then an error message will appear
 - And no update will be made
- Scenario 2: New info is valid
 - Given new information a provider wants to input
 - When user enters that information to update
 - And the information is valid
 - Then a success message will appear
 - And the update will be made

As a user I can recover/change my password so that I can log into my account if I forgot my password.

Estimated time to complete: 14 days

Acceptance Criteria: Have a link to a dedicated page for password recovery. Pass manual test of the password recovery process. Have and pass unit tests and integration tests covering components related to the password recovery process.

- Scenario 1: Given invalid email
 - Given a user enters an invalid email to receive a new password
 - When user enters the email for password recovery
 - And the email is invalid
 - Then an error message will appear
 - And nothing will be done
- Scenario 2: Given valid email
 - Given a user enters a valid email to receive a new password
 - When user enters the email for password recovery
 - And the email is valid
 - Then and success message will appear asking to check their email
 - And email will have a confirmation link
 - And if clicked will return a new password

As a user I can mute/turn off my a/v communication

Estimated time to complete: 2 days

Acceptance Criteria: In a call, a user will be able to click a button to mute/turn off a/v communication.

Github link (prototype):

<https://github.com/BLimmie/intouch-health-capstone-2019/commit/174f84c3cec02ece4816a5543a4edb82f71da48b>

- Scenario 1: User does not have their a/v muted or turned off
 - Given that the user clicks on the microphone and video icons
 - And another user stays on the session
 - When the user speaks or sends local video stream
 - Then the other user should see a black screen
 - And hear no audio
- Scenario 2: User does have their a/v muted or turned off
 - Given that the user clicks on the microphone and video icons
 - And another user stays on the session
 - When the user speaks or sends local video stream
 - Then the other user should see the user
 - And hear audio

As a user I can enable/disable the remote video feed fit to the whole screen.

Estimated time to complete: 3 days

Acceptance Criteria: In a call, a user will be able to click a button to enable/disable fullscreen video.

Github link (issue): <https://github.com/BLimmie/intouch-health-capstone-2019/issues/13>

- Scenario 1: User does not have the remote video on fullscreen
 - Given that user is in a call with another user
 - And the other user stays on the session
 - When the user clicks the icon for enabling fullscreen
 - Then the remote feed should fit the users whole screen.
- Scenario 2: User does have the remote video on fullscreen
 - Given that user in ina call with another user with fullscreen enabled
 - And the other user stays on the session
 - When the user clicks the icon for disabling fullscreen
 - Then the remote feed should return to the original interface

As a provider, I can visualize session data in a graph over time for each of my patients

Estimated time to complete: 6 days

Acceptance Criteria: A provider will be able to log in, then click on a certain patient. This patient's cumulative emotion levels over all sessions will then be displayed on a line graph.

- Scenario 1: Patient has at least more than one sessions recorded
 - Given that the provider has logged in successfully
 - and that the patient is under the provider asking for the data
 - and there exists previous session data
 - When the provider asks for the graphs
 - Then a graph over time of the patients emotions should appear
- Scenario 2: Patient has no previous sessions recorded
 - Given that the provider has logged in successfully
 - and that the patient is under the provider asking for the data
 - and there does not exist previous session data
 - When the provider asks for the graphs
 - Then an error should pop up, informing the provider that the patient has no previous session data

As a user in a call, I am able to toggle open a chatbox to send a message to the other user in the call

Estimated time to complete: 5 days

Acceptance Criteria: In a call, be able to toggle open/close the chat box and send and receive messages.

- Scenario 1: Chat is successfully received
 - Given that both users are in a session
 - When a user clicks on the chat box icon
 - Then the user will open the chat box and be able to send a message to the other user
- Scenario 2: Chat is not received successfully
 - Given that both users are in a session
 - When a user clicks on the chat box icon
 - And the user sends a message to the other user in the call
 - And the message fails to be sent
 - Then an error message will appear in the chatbox
 - And the user will be able to try to send the message again.

As a provider, I can share session data analysis for a patient with other providers so that I can work with other providers easily.

Estimated time to complete: 4 days

Acceptance Criteria: Allow a provider to access patient data for a patient that was previously not their own.

- Scenario 1: Provider is able to share data with another provider
 - Given that both providers are authorized providers

- And a provider wants to share data to another provider
- When the provider selects the data they want to share
- And enters the provider they want to share the data with
- Then the other provider will have access to the selected session data.
- Scenario 2: Provider is not able to share data with another provider
 - Given that the other provider is not authorized
 - And a provider wants to share data to that provider
 - When the provider selects the data they want to share
 - Then the other provider will still not have access to the selected session data.

As a provider, I can remove a patient from my list of patients

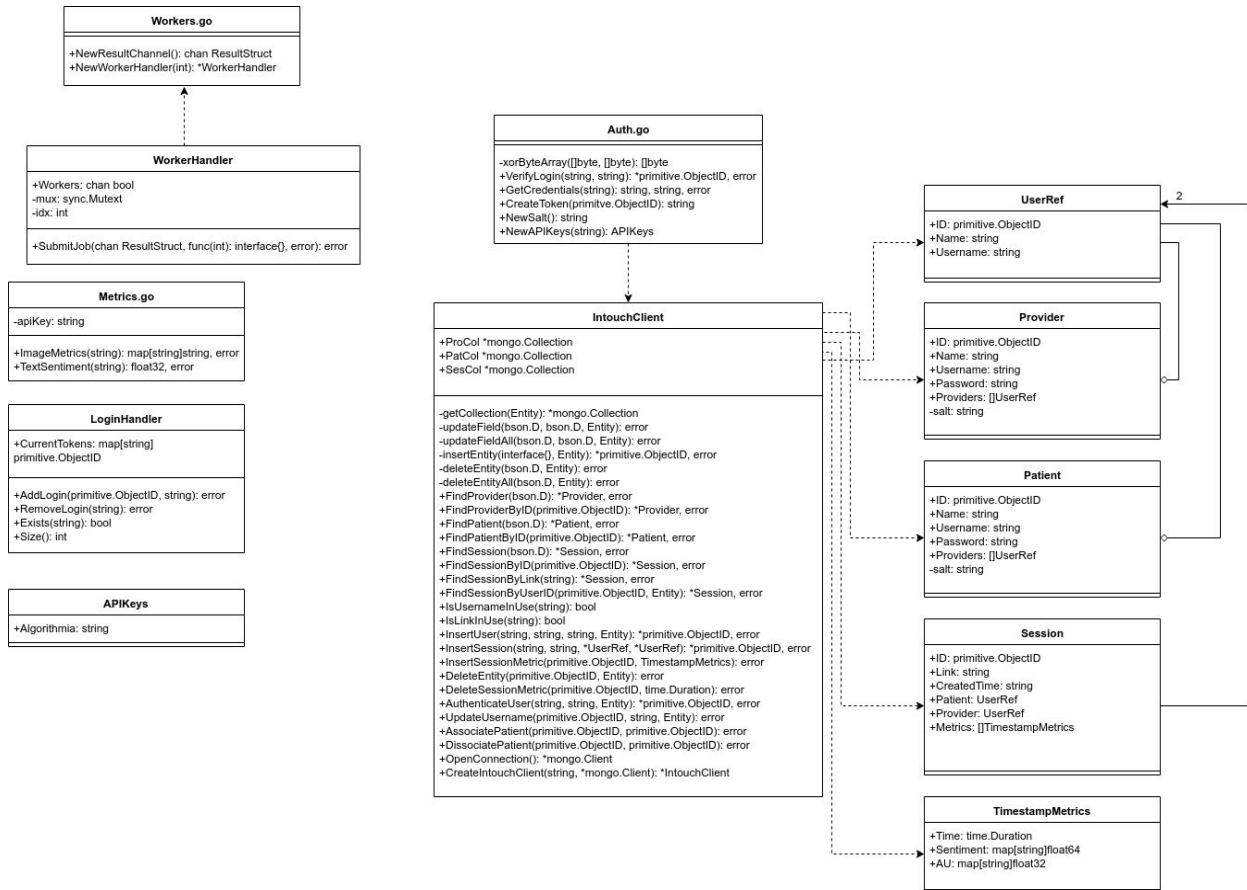
Estimated time to complete: 5 days

Acceptance Criteria: After removing a patient for a provider, they will not be able to access their data.

- Scenario 1: Provider is able to delete the patient from their patient list
 - Given that the provider is authorized
 - And the patient they want to remove is listed under them
 - When the provider selects to remove the patient
 - Then the provider will no longer have access to that patients data
- Scenario 2: Provider is able to delete the patient and the patient has no more connected providers
 - Given that the provider is authorized
 - And the patient they want to remove is only listed under them
 - When the provider selects to remove the patient
 - Then the provider will no longer have access to that patients data
 - And the patients profile and data will be deleted

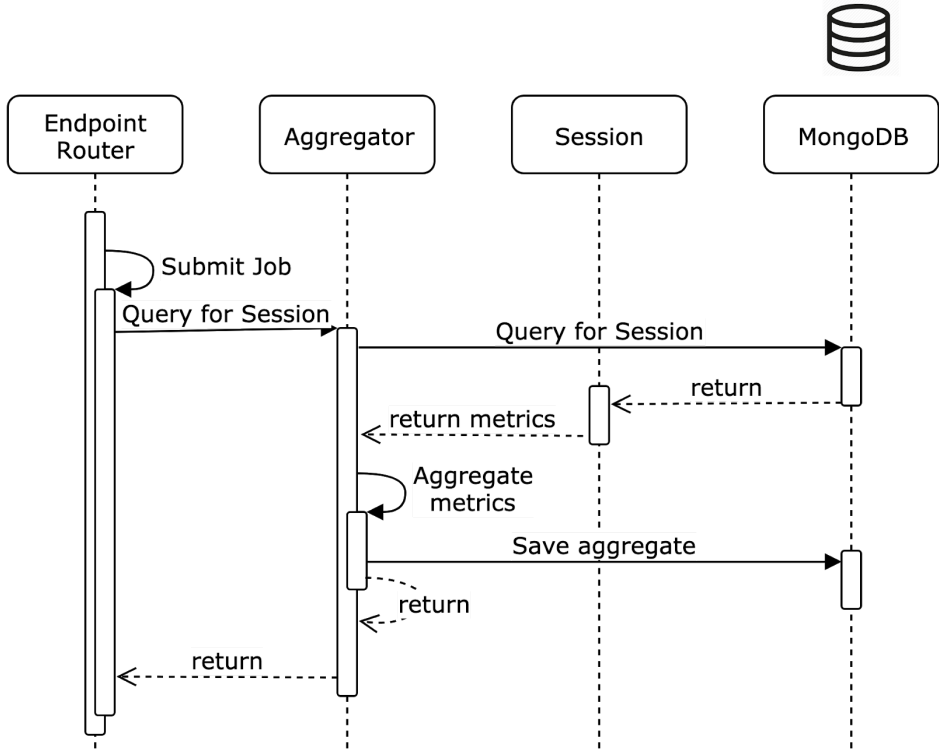
System Models

UML Class Diagram

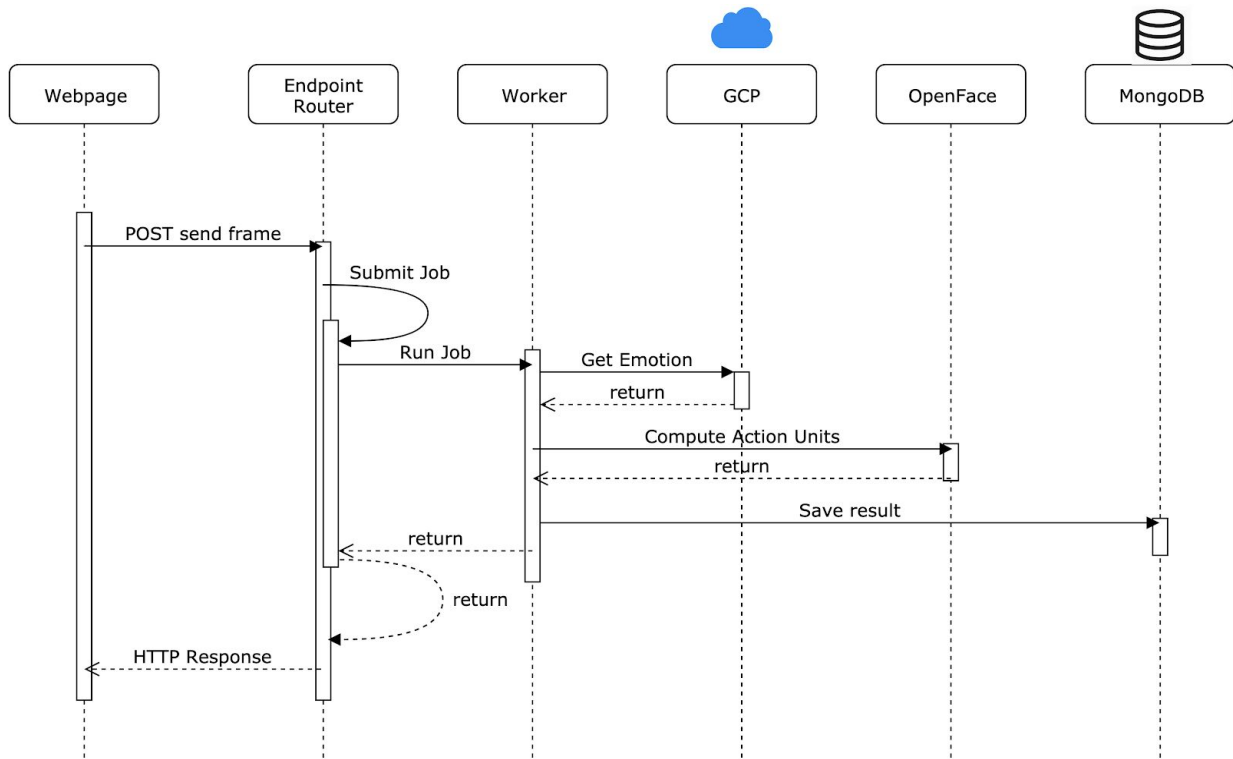


Class Interactions Sequence Diagrams

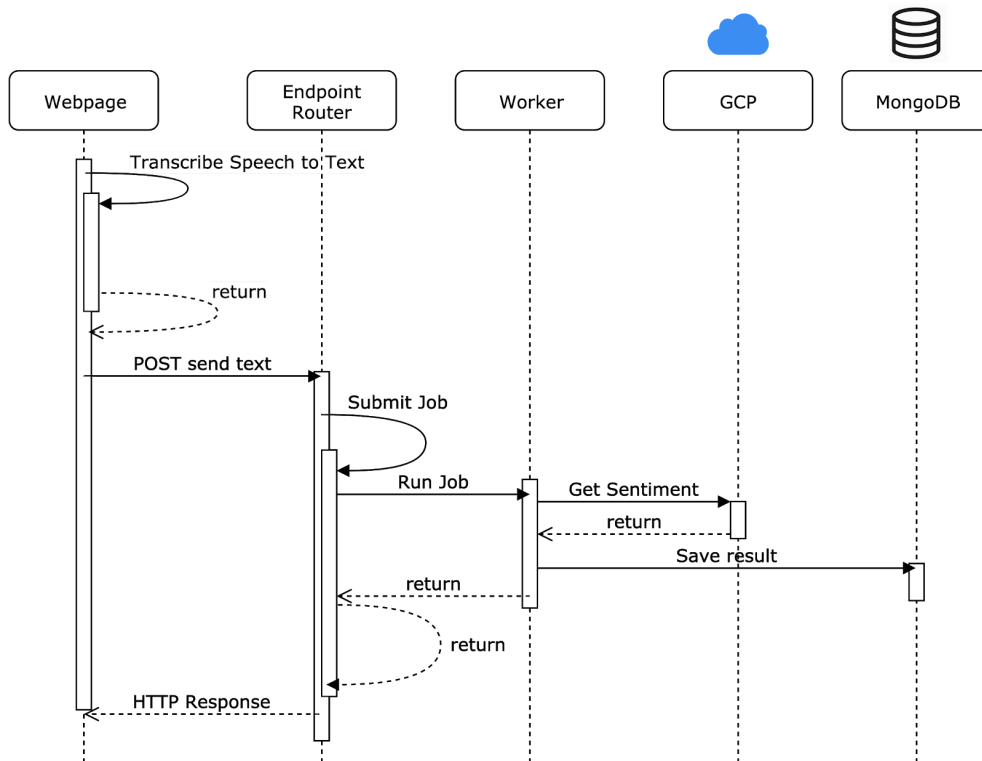
Aggregate Metrics



Vision/Facial Analysis



Speech/Text Analysis



Appendix

Technologies Employed

React: Frontend elements, including video streaming capabilities (WebRTC)

Gin / Golang: Backend REST API router

Material-UI: Frontend elements, excluding audiovisual capabilities

Charts.js: Frontend charts for visualization of data, mainly emotions

MongoDB: NoSQL Database for storing user info and sessions

OpenFace: Library that extracts information from faces

Google Sentiment Analysis: Detects sentiment in text

TypeScript/JavaScript: Frontend elements, basis for React and Material-UI