

Project Requirements Document, Version 2

Project: Improving Clinical Quality of Telehealth Consults

Project Name: TeleHance

Team Name: SALT

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Intro

Background

Doctors are working in an increasingly virtual environment and need to adapt quickly to the use of telehealth consults. The current telehealth consultation process is intensive for the physician as they need to fill the role of both a doctor and scribe. This makes it difficult for physicians to keep track of patient symptoms and medical information. Additionally, clinics have a hard time maintaining and improving the clinical quality of these telehealth consults-- Teladoc facilitates over 10 million of these virtual medical consultations annually. In addition, the emergence of the novel coronavirus is causing this number to rise. Thus, we are introducing a platform that proactively identifies problematic consults and enables clinics to identify causes for aggressive consults and/or malpractice. The platform's function is twofold: serve as a telescribe and provide doctors with a report of conditions (along with underlying symptoms commonly associated with these conditions).

Objective

Building trustful relationships between doctors and patients is one of the most integral problems in telehealth consults -- in order to make medical consultations more trustworthy, it becomes crucial to identify problematic consultations, defined as consultations with cases of malpractice or toxicity in the respective conversation. Despite there not being many of these problematic cases, identifying said cases is especially crucial in mitigating future incidents that would further erode trust between the doctor and patient. Currently, nurses are the ones who go through the consultations, but this manual review is a time consuming process that may not find every instance of problematic consultations (also relatively dependent on the nurse that goes through the consultations).

Clinics want to prevent unreasonable/unwarranted ratings for their doctors in a uniform manner but are unable to identify malpractice automatically.

Another problem is making sure doctors ask the right questions. During telehealth consultations, doctors might have limited time to meet with patients and thoroughly study patient data. Consequently, doctors may have a hard time asking about the patients' symptoms in depth within the provided time constraint.

Innovation

We are developing a novel platform that enables Teladoc to retroactively identify problems within their consults. Furthermore, we are easing the interaction between doctors and patients by warning doctors about problematic conversations. Second, we are providing a telescribe service that allows doctors to focus on their consultations. Our tool provides doctors with the ability to reanalyze sessions with patients so that future teleconsults can be improved. Additionally, this ensures that valuable information uncovered during the consultation is not lost.

Technology

We do not require proprietary hardware for the use of our platform. This tool is used to serve as a data analytical tool based on the audio and video recorded during a telehealth consult at Teladoc Health. We assume that most of the auditors of these consults will want post processing of the data. However, doctors will want real time and post processing of this same data. During the sessions, doctors will be looking at the sentimental analysis data that is collected in order to adapt and change during the consultation. Patients should be able to view the consultation transcript as well as their own personal health data. We assume that patients have legally agreed to the services that our software provides.

We have decided to build our service as a serverless application. This allows us to utilize AWS to delegate and manage our backend services. Our Frontend will consist of a React application built using Material UI components. These components will allow us to make use of styled components that are faster and easier to develop with. In order to handle authentication, we will make use of Auth0 and Google OAuth services to verify that the users logged in have access to the patient data. This React application will connect to RESTful APIs built using AWS Lambda Functions and the AWS API Gateway. The RESTful API will allow us to query and manipulate our data stored on a DynamoDB database. The data that our services handle is best suited to the flexibility of NoSQL databases. Much of the data we are using will not have inherent relationships between entities that can be taken advantage of through a SQL database. Furthermore, we will make use of Amazon Transcribe and Amazon Medical Comprehend in order to develop an information extraction system that allows us to summarize the audio of consults into symptoms.

Motivation

Being able to identify problematic consultations will greatly improve the respective quality of said consultations for both the doctor and patient. Particularly In the patient's case, he or she will benefit from doctors being held accountable for malpractice such as bad drug or operation recommendations. Furthermore, patients will also benefit from doctors being held accountable for overt aggression in a consultation. In the doctor's case, they will benefit from the identification of a patient who berates a doctor by asking for a drug and subsequently giving the doctor a bad rating after not receiving that drug.

If a doctor does not ask the right questions, they may prematurely prescribe a certain drug or make an incorrect recommendation -- if we can make sure that the doctor is asking the right questions based on a patient's information, we can increase certainty that the patient is getting the best recommendation.

Currently nurses manually review a subset of telehealth consultations. This causes many problematic consultations to go unnoticed by auditors. Clinics are unable to reflect on potential improvements that can be made to improve the clinical quality of telehealth consultations. Furthermore, telescribe services are still maturing and doctors are unable to rely on human scribes during telehealth consultations. The result of this is additional work for physicians as they need to ask questions and question the patient to better understand the medical history. As a result, doctors may miss key information provided during the consultation due to a lack of records. This leaves patients frustrated with the subpar clinical care received during telehealth consultations.

Goals

Our goal is to create an application that doctors, patients, and auditors can use. The third-party analysis tool that objectively identifies malpractice or anomalies in consults could enable clinics to provide more reliable services. It could transcribe patient symptoms, suggest relevant symptoms to doctors, and provide additional information to the patients. Doctors could benefit from diagnostic assistance in analyzing symptoms and conduct more effective consultation for patients.

For patients, this will show them the transcript of the consultation and any diagnosis/recommendation. For doctors, this will show them a real time analysis of the consultation for instances of toxicity in the conversation. It will also show them potential conditions associated with symptoms given by the patient so the doctor can ask relevant questions. After the consultation, the doctor will be able to see the full transcript of the conversation and be able to search for specific keywords and be taken to instances of those keywords within the transcript. The doctor's view will still show potential conditions associated with the symptoms. For auditors, this will show them consultations in a ranked

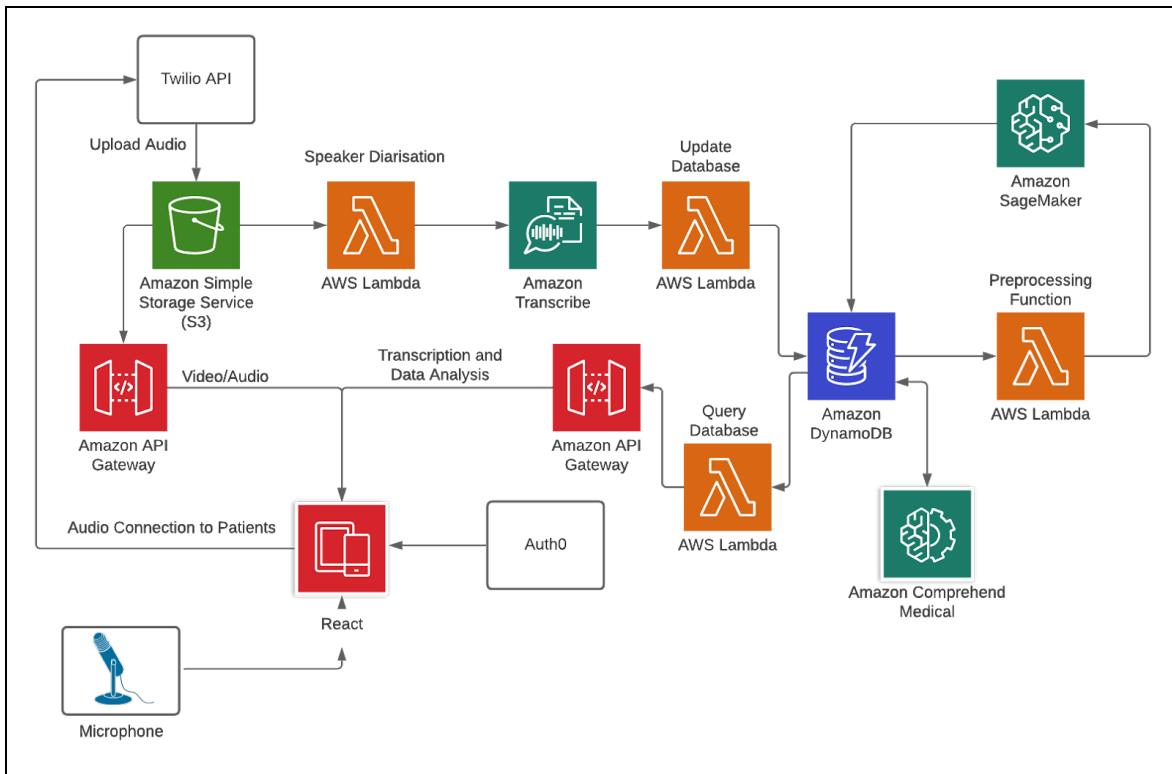
list in order of most problematic to least problematic. Therefore, an auditor can click on a flagged conversation and be shown the instances in the transcript where there may be malpractice or aggression.

Conclusion

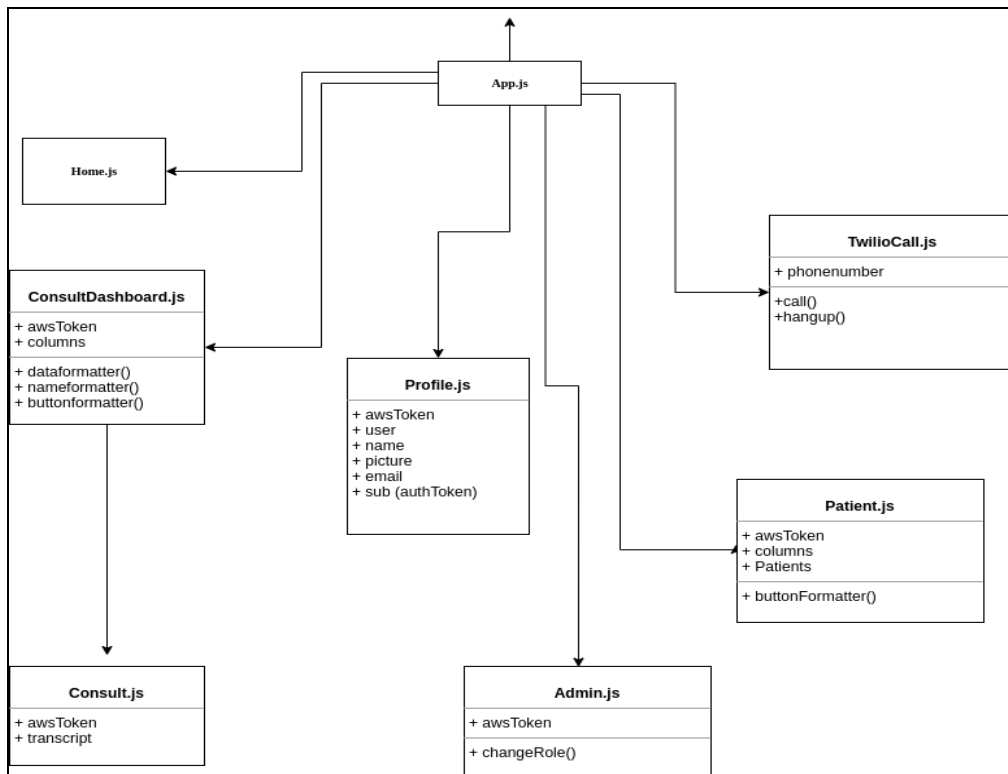
Our team is building a web application designed to enable Teladoc Doctors and Auditors to identify problems within Telehealth consultations. Doctors will be provided with alerts when problems arise as well as an automated telescribe, ensuring that key information is not lost during the consultation process.

System Architecture

High Level Diagram

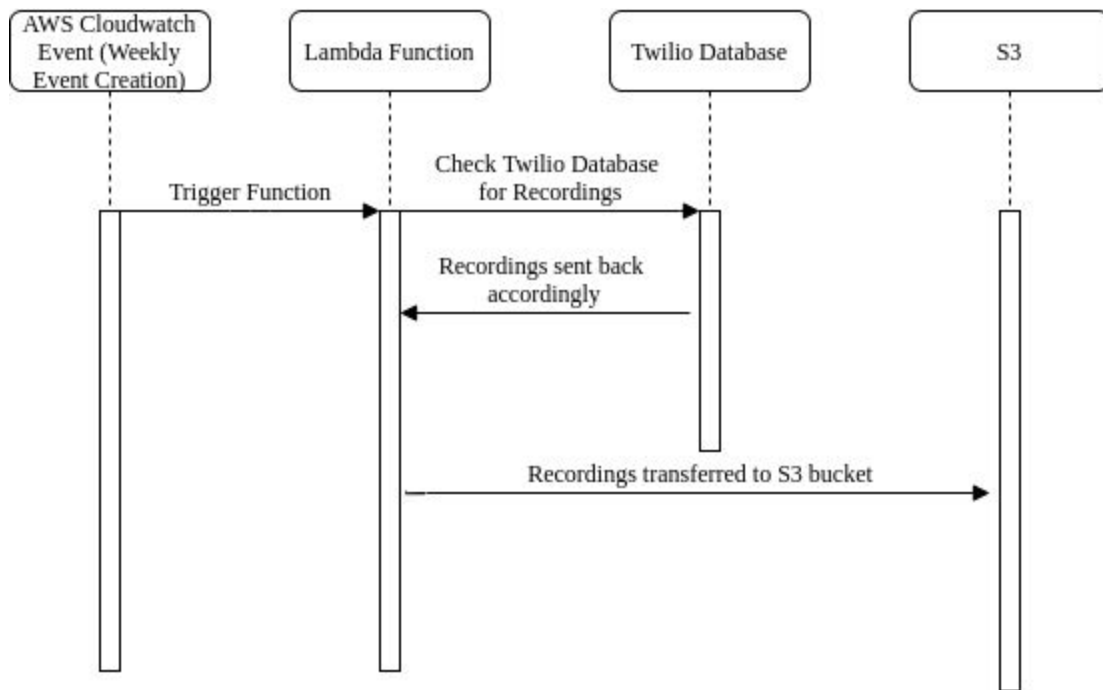


Front-End UML Diagram

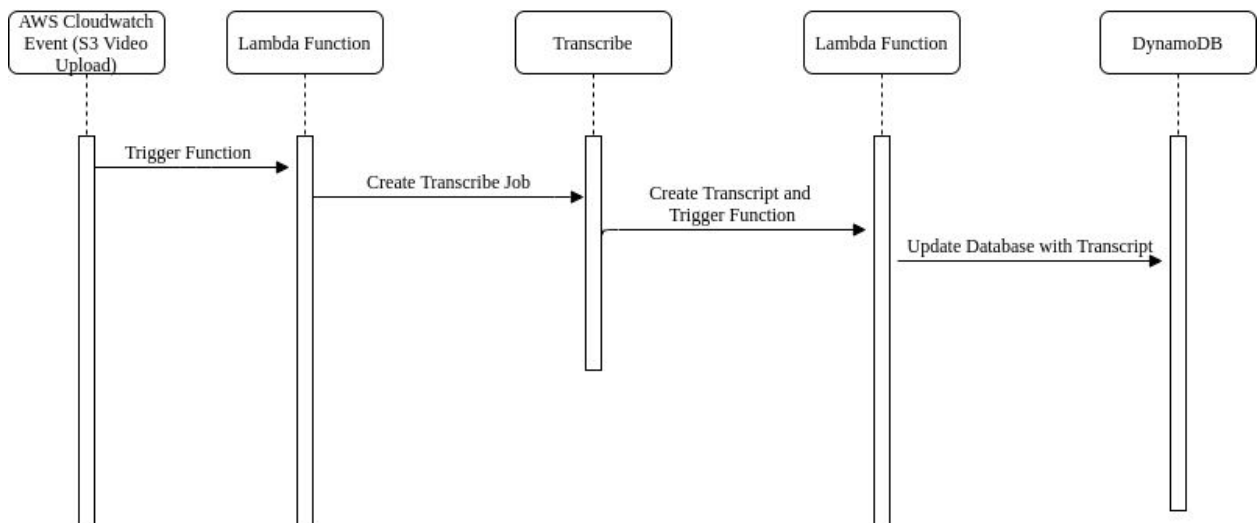


Model Sequence Diagram

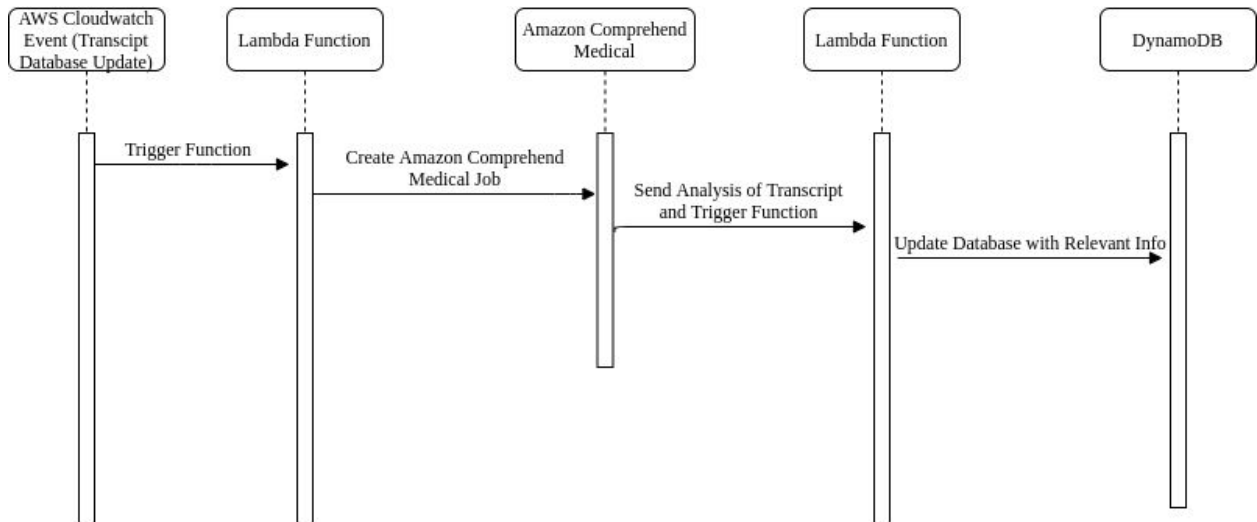
1) Storing Call Recordings



2) Uploading Video




3) Updating Consult Items in Database



Login Page

The screenshot shows the login page for Teladoc Health. At the top left is the Teladoc Health logo. Below the logo, there is a dark blue background with a light blue box labeled "Service Name". To the right of the "Service Name" box are two input fields: "username" and "password". Below these fields is a blue "Log In" button. The page has a light blue footer bar at the bottom.

Consult Dashboard




Search for Keywords

Consult #	Doctor	Consult Text Match	
Consult 1	XXXXXXXXXX		View
Consult 2			View
Consult 3			View
Consult 4			View
Consult 5			View
Consult 6			View
Consult 7			View
Consult 8			View
Consult 9			View
Consult 10			View
Consult 11			View
Consult 12			View

UI Design (Doctor and Auditor View)

Service name Home Log Out



Patient Jane
Past Record

Dr. John

Hi Jane, how are you today?

Patient Jane

I've experienced asthenia in the past few days, but today I also felt a slight pain in my chest. I'm a bit worried that my condition is worsening.

Dr. John

I'm sorry to hear that. Try to take it easy and let's try to figure out what's going on. Did anything happen lately?

Patient Jane

Dr. John

Patient Jane

Results Symptoms Emotion

Keywords: pain chest asthenia orthopnea nightmare agitation cough


search

This is a search result. Click on me and I will go to that instance in the text.

Notes:

Submit

Service name Home Log Out

 Patient Jane
Past Record

Dr. John
Hi Jane, how are you today?

Patient Jane

I felt asthenia in the past few days but today I even got slight pain in my chest. I'm worried if I need to take any subscription for it.

Dr. John
I'm sorry to hear that, but take it easy. Let's go step by step. Did anything happen lately?

Patient Jane

Dr. John

Patient Jane

Results Symptoms Emotion

Keywords: pain chest asthenia orthopnea
nightmare agitation cough

x pain chest x orthopnea x asthenia


Diabetes looking for this? ☆

polyuria pain chest asthenia
shortness of breath sweating increased
orthopnea labored breathing

Notes:

Submit

Service name Home Log Out

 Patient Jane
Past Record

Dr. John
Hi Jane, how are you today?

Patient Jane

I felt asthenia in the past few days but today I even got slight pain in my chest. I'm worried if I need to take any subscription for it.

Dr. John
I'm sorry to hear that, but take it easy. Let's go step by step. Did anything happen lately?

Patient Jane

Dr. John

Patient Jane

Results Symptoms Emotion

Keywords: doing okay

Overall Score: 7.3
Content: Neutral
Tone: Positive
Volume: Normal
Inappropriate Language: 7

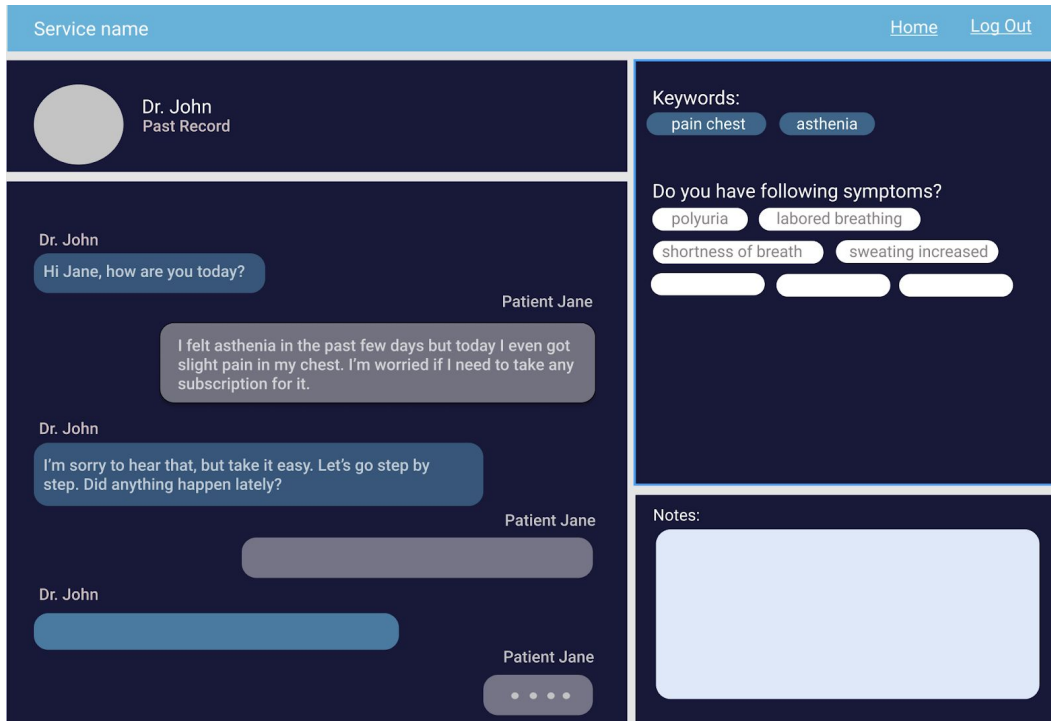
Suggested Action :

Report

Notes:

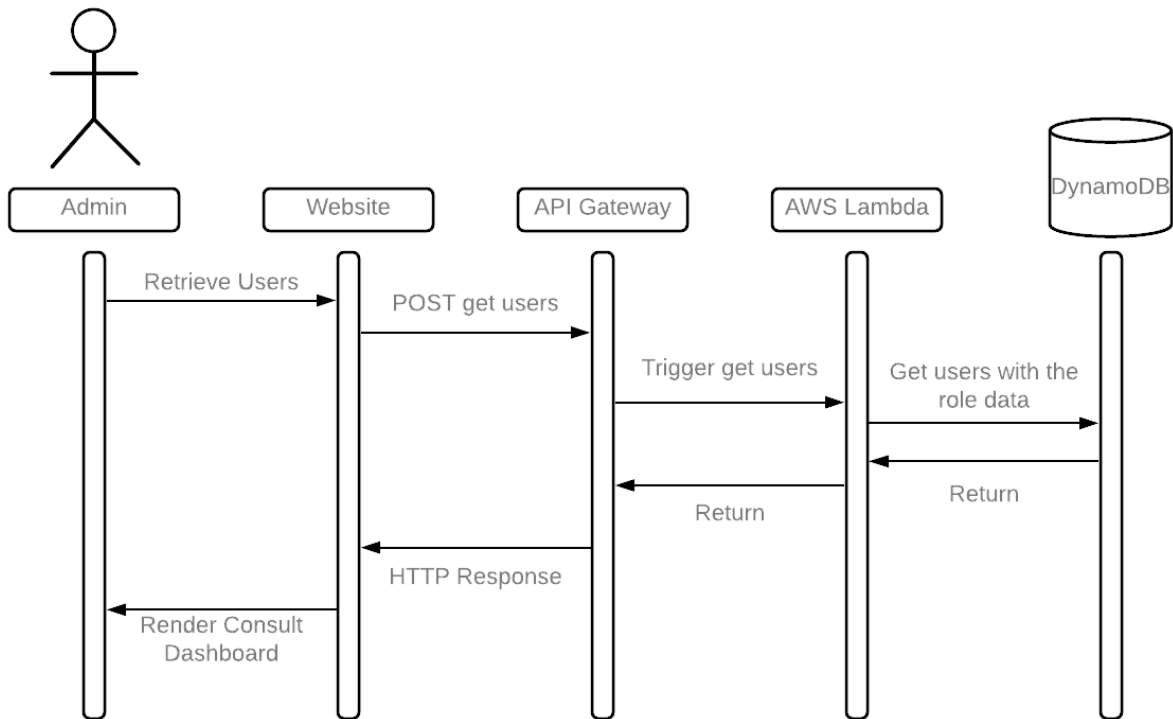
Submit

UI Design (Patient View)

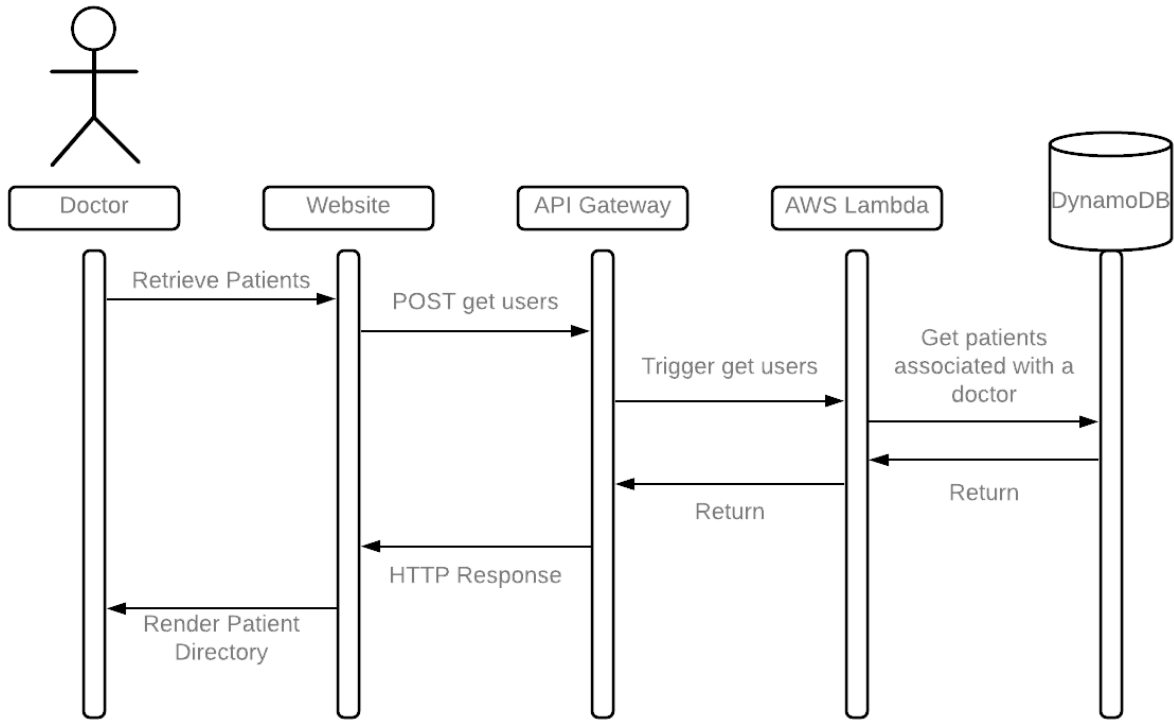


User Interaction and Design

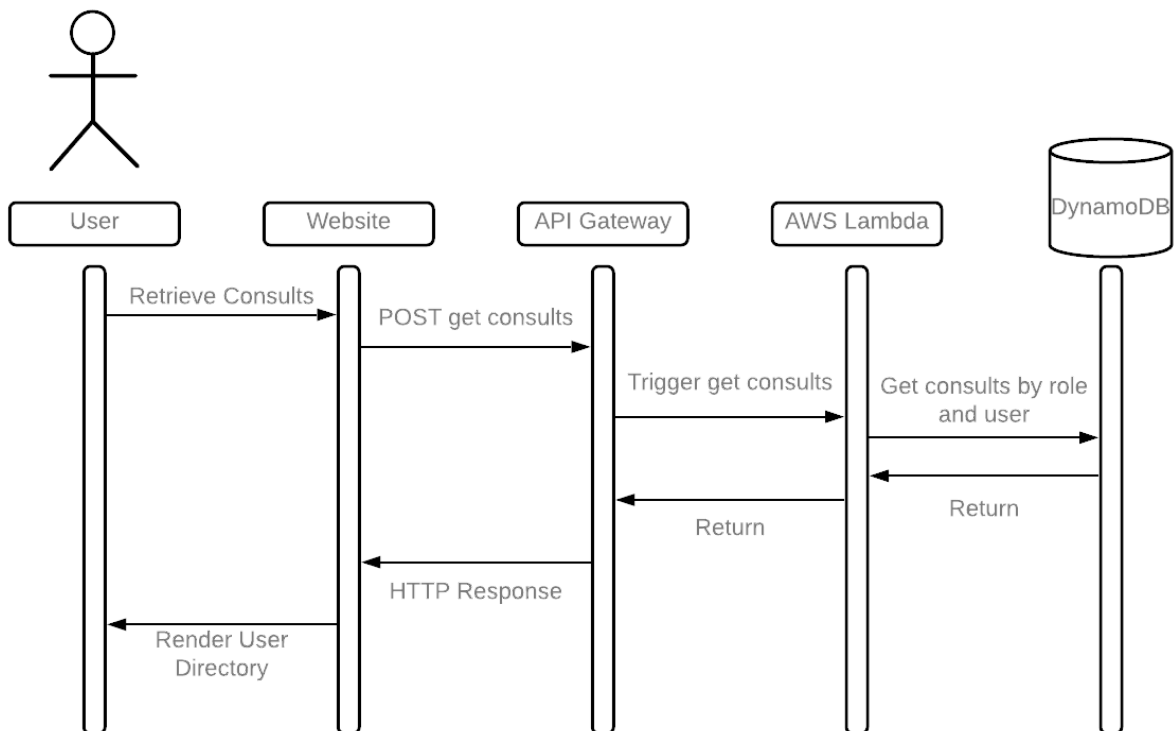
Admin gets users



Doctor gets patients



User gets consults



All Users

The first instance of interaction on our web application is the user authentication. Users will be able to sign in with their Gmail credentials. Upon doing so, that user will be created as a patient account. Admin users will be able to promote new users to a different type of user (Doctor or Administrator). After logging in, users will be able to gain access to user specific features tied to their account.

Admin Users

Admin users will be able to view and query all of the telehealth consults on the platform. They will be able to search for keywords or sort consults by a toxicity rating. Admin users will be able to view individual consults to investigate potential issues within each consultation. Each consult will list transcripts of the telehealth consult as well as symptoms identified during the consultation. The Admin would also be able to view the reasons the consult was classified as problematic and query the transcript to find potential problems. Admin users will be able to view all users of the platform and promote these users to new roles within the platform. This allows admins to provide doctors with the permissions to view their consultations as well as the patient directory.

Doctor Users

Doctor users will be able to view and query all of their past telehealth consults on the platform. They will be able to search the transcripts for keywords and look up patient records. Doctors will be able to view individual consults in order to reference a list of the patient's symptoms. Each consult will also list potential conditions along with potential symptoms to prompt the physician's line of questioning. The doctor would also be warned if the consult becomes aggressive or results in malpractice. Doctors can access a patient directory that allows them to initiate a telehealth consultation with any of their patients.

Patient Users

Patients would be able to view and query all of their past telehealth consults on the platform. They would be able to query the transcripts and view individual consults. Patients would also be able to view the list of the symptoms discussed during the consultation.

Requirements

Logging in/Signing up

As a User, I can visit the web application and log in via Google OAuth so that I can access all past consultations.

Estimated time to complete: 7 days

Priority: 1

Acceptance Criteria: Pass manual test for logging in. Have and pass unit tests and integration tests covering components on the home and profile page.

Github Commit:

<https://github.com/tkomarlu/TeladocCapstone/commit/2c50cdd6bb54f723d1a113860c925e826b234c03>

- Scenario 1: User enters the wrong username or password
 - "Incorrect username/password" message will be displayed
 - User will be prompted to enter their username/password again
- Scenario 2: User enters the wrong username and password multiple times over a small time interval
 - "Too many attempts to login" message will be displayed
 - User will be temporarily barred from logging in for a certain time interval
- Scenario 3: User enters the correct username/password
 - Account info page will be displayed.

As an Administrator, I can give doctors identities by promoting them to "Doctor" from "Patient" so that doctors can have "Doctor" permission to view tables and make calls to patients.

Estimated time to complete: 3 days

Priority: 1

Acceptance Criteria: After updating the identity information, Doctor users could see the more consultations on the search page and Patient Contacts in the Navigation Bar once refresh the page or re-loggin.

Github Commit:

<https://github.com/tkomarlu/TeladocCapstone/commit/19c4d28b9229229f88d74b5289e6e48c0c26d2>

- Scenario 1: Administrator gives permission to doctor.
 - Doctors now have permission to view additional information.
 - Administrator give doctor permission to patients can later modify by enabling the permission

Profile Setup/Look-up (During or Before the Call)

As a Patient, I can fill in my basic information (gender, race, height, weight, etc.) and medical record on a voluntary basis on the user's profile page so that doctors will have more information to know about my current status.

Estimated time to complete: 2 days

Priority: 2

Acceptance Criteria: After filling the information on the profile page and clicking confirm, users can see their information updated on the profile page. The user's information will only be visible to his/her doctors.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/14>

- Scenario 1: Users enter information on his/her profile page correctly but doesn't click confirm
 - When refreshing the page, they will lose their inputs.
- Scenario 2: Users enter information on his/her profile page correctly and click confirm
 - When refreshing the page, their inputs will be shown on the form. Their information is also stored in the backend into S3 bucket.
- Scenario 3: Users enter information on his/her profile page wrongly. E.g. Put words in height and weights.
 - The inputs are not accepted with error msg 'Please input numbers'.

As a Doctor, I can see patients' personal records of (*the reports of) past consultation during or after consultation so that with more information, I may provide better suggestions to patients during current consultation.

Estimated time to complete: 7 days

Priority: 2

Acceptance Criteria: When clicking on the patient's profile photos, doctors can see and query patient's past consultations (either URLs or reports). Have and pass unit tests and integration tests covering components between consultation and user profile page.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/14>

- Scenario 1: Patient doesn't have past consultation and is a new user to the platform
 - They can successfully click and select sentences or words.
- Scenario 2: Patient has multiple past consultation.
 - Consultation information shows up.

As a Doctor, I can see patients' profile photos and their background information provided by the patients so that I may provide better consultation services.

Estimated time to complete: 2 days

Priority: 2

Acceptance Criteria: When clicking on patient's profile photos, doctors can see background information that patients put into the profile themselves. Have and pass unit tests and integration tests covering components on the user profile and consultation page.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/14>

- Scenario 1: Patients haven't provided information in their profiles.
 - The background information is blank.
- Scenario 2: Patients have provided information in their profiles.
 - The background information shows up.

Audio Connection

As a Patient, I can submit a form with my phone number on the main page so that doctors can call me.

Estimated time to complete: 1 day

Priority: 1

Acceptance Criteria: The entered phone numbers are shown in the patient contact table and will later be updated on the User Profile Page (in Priority 2 after construction). Have and pass unit tests and integration tests covering components on the patient contact page.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/15>

- Scenario 1: Users enter words instead of number.
 - The inputs are not accepted with error msg 'Please input numbers'.
- Scenario 2: Users enter valid phone number.
 - The inputs are accepted and recorded.

As a Doctor, I can view a list of patients to call so that I can initiate consultations.

Estimated time to complete: 1 day

Priority: 1

Acceptance Criteria: Users that have Doctor permission can see and interact with the patient contact table. Have and pass unit tests and integration tests covering components on the patient contact page.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/15>

As a Doctor, I can initiate calls to the patient via Twilio by clicking the entry on the patient contact table and start an individual consult page so that I can have a conversation with patients.

Estimated time to complete: 2 days

Priority: 1

Acceptance Criteria: Pass manual test of initiating a call to a patient when logged in as a doctor

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/7>

- Scenario 1: Call is successfully initialized
 - Users on the call can hear each other's voice. Patient can hear the voice from the phone. Doctors can hear the voice from the browser.
- Scenario 2: Call is not initialized successfully
 - Users on the call cannot hear each other's voice. Either the patient can hear the voice from the phone or the doctor can hear the voice from the browser.
 - Users will see an error image in the conversation view.

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

Estimated time to complete: 1 day

Priority: 1

Acceptance Criteria: Pass manual test of listening to a call on the platform when logged in as a doctor

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/7>

- Scenario 1: Audio is successfully received
 - Both patient and doctor are in the same session
 - The conversation views are the same.

Consultation Page (During Call)

As a User, I can see the web page for individual consultations with the other speaker's profile and a conversation view so that I can interact with another user, and communicate with them more effectively.

Estimated time to complete: 3 days

Priority: 1

Acceptance Criteria: Pass manual test for viewing individual consult page

Github Commit:

<https://github.com/tkomarlu/TeladocCapstone/commit/b2d7860196809b98121b2b68dcf71d2b6ef44708>

- Scenario 1: The consultation is live.
 - The conversation view will keep updating as the call goes on.

- Scenario 2: The consultation is finished.
 - The conversation view is unchanged.

As a Doctor/Admin, I can see the evaluation score of the toxicity of the consults based on content (if there're inappropriate languages) for myself and patient respectively during and after each session. If the score is high I will be alerted so that I can identify misconduct accordingly.

Estimated time to complete: 1 day

Priority: 1

Acceptance Criteria: Pass manual test for viewing sentiment analysis score on the individual consult page when logged in as a doctor or admin

Github Commit:

<https://github.com/tkomarlu/TeladocCapstone/commit/b2d7860196809b98121b2b68dcf71d2b6ef44708>

- Scenario 1: Score of consult is below threshold
 - Score will be displayed in red next to the consult along with a tag. Doctors can hover over the tag to see a brief reason for why the consult was singled out.
- Scenario 2: Score of consult is above threshold
 - Score will be displayed alongside the consultation in question.

As a Doctor/Admin, I can see the evaluation of consults based on tone and voice volume for myself and patient respectively during and after each session so that I can know if either user is behaving properly.

Estimated time to complete: 3 days

Priority: 2

Acceptance Criteria: Pass manual test for viewing individual

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/9>

- Scenario 1: Score of consult is below threshold
 - Score will be displayed in red next to the consult along with a flag. Doctors can hover over the flag to see a brief reason for why consult was flagged.
- Scenario 2: Score of consult is above threshold
 - Score will be displayed alongside the consultation in question.

As an Admin, I can see whether consultations are toxic in the main search page so that I can identify toxic consultations efficiently.

Estimated time to complete: 2 days

Priority: 2

Acceptance Criteria: Pass manual test of viewing toxicity tags for each consult on the consult dashboard as an admin

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/9>

- Scenario 1: Score of consult is below threshold
 - Score will be displayed in red next to the consults along with a flag. Admin can hover over the flag to see a detailed reason and click for more information. Admin can also indicate whether they agree or disagree with the classification.
- Scenario 2: Score of consult is above threshold
 - Score will be displayed alongside the consultation in question.

As a Doctor/Admin, I can see a ranking of suggested medical conditions associated with the current patient's symptoms so that I can ask if the patient has other symptoms associated with the medical condition to make a more accurate diagnosis.

Estimated time to complete: 2 days

Priority: 2

Acceptance Criteria: Pass manual test of viewing potential symptoms in individual consult page when logged in as a doctor or admin

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/8>

- Scenario 1: Highlighted symptoms are misidentified.
 - Doctor removes the symptom from the medical report.
- Scenario 2: Non highlighted symptoms have not been discussed yet.
 - Doctor can proceed to ask the patient about the symptoms.
- Scenario 3: Consultation flagged for review
 - Admin can check if the Doctor asked the correct questions.

As a Patient/Doctor, I can highlight the dialogues and notes that are important so later I can come back and review.

Estimated time to complete: 3 days

Priority: 2

Acceptance Criteria: Patients select words and sentences. The selected contents are automatically highlighted. Have and pass unit tests and integration tests covering components on the consultation page.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/17>

- Scenario 1: Patient select words and/or sentences.
 - The content is highlighted.

- Scenario 2: Patient select the same words and/or sentences again
 - The content is not highlighted.

As a Doctor, I can leave notes on the same page of the transcribe during the consultation so that patients will know the key takeaways.

Estimated time to complete: 3 days

Priority: 2

Acceptance Criteria: upon clicking the 'submit' button, the notes in the textbox will be stored in the consultation S3 table. The notes would remain in the textbox. Have and pass unit tests and integration tests covering components on the consultation page.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/16>

- Scenario 1: Doctor tries to put photo in the box
 - Error returns "Invalid input"
- Scenario 2: Doctor tries to put text in the box
 - The inputs are accepted and saved.
- Scenario 3: Doctor exits the consultation page and re-enters
 - If the note is submitted, the doctor can still see the notes.

As a Patient, I can see the notes that doctors leave so that I'll keep updates on what doctors think is important.

Estimated time to complete: 3 days

Priority: 2

Acceptance Criteria: After doctors submit notes, patients can receive the notes within 5-second delay. Have and pass unit tests and integration tests covering components on the consultation page.

Github Issue: <https://github.com/tkomarlu/TeladocCapstone/issues/16>

- Scenario 1: Patient tries to click and select notes in the textbox
 - He/She can successfully click and select sentences or words.
- Scenario 2: Patient tries to edit notes in the textbox
 - He/She cannot edit notes.
- Scenario 3: Patient tries to highlight notes in the textbox
 - He/She can successfully highlight the notes.
- Scenario 4: Patient exits the consultation page and re-enters
 - He/She can still see the notes.

Search/Query Page (Tables of Consultation)

As a Doctor/Patient, I can search keywords over past transcriptions, view matched context and listen to consultation records only of my past consultations so that I can review past consult records and find key information.

Estimated time to complete: 3 days

Priority: 2

Acceptance Criteria: Pass manual test for searching consults in consult dashboard when logged in as a doctor or patient. Have and pass unit tests and integration tests covering components on the consult dashboard page.

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/3>

- Scenario 1: Keyword does not appear in any transcription
 - "Your query "[insert query]" did not yield any results" message will be displayed
- Scenario 2: Keyword appears in text for transcription (search by occurrence of word)
 - Number of instances per transcription will be displayed alongside each transcription, which will be shown in chronological order (for the doctor, the option to sort by patient will also be provided)

As an Admin I can search keywords over past transcriptions, view matched context and listen to consultation records of all past consultations so that I can review past consult records and find key information for the audit purpose.

Estimated time to complete: 3 days

Priority: 2

Acceptance Criteria: Pass manual test for searching consults in consult dashboard when logged in as an admin

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/3>

- Scenario 1: Keyword does not appear in any transcription
 - "Your query "[insert query]" did not yield any results" message will be displayed
- Scenario 2: Keyword appears in transcriptions
 - Number of instances per transcription will be displayed alongside each transcription, which will be sorted by chronological order

As a User, I can search or select suggested keywords (e.g. diseases, symptoms, conditions) on individual consult pages and see the context of the keywords within the transcript so that I can more efficiently review the consultation.

Estimated time to complete: 5 days

Priority: 2

Acceptance Criteria: Pass manual test of viewing all keywords on the individual consult page when logged in as any user

Github Issues: <https://github.com/tkomarlu/TeladocCapstone/issues/8>

- Scenario 1: Desired keyword appears in suggestions
 - User selects the respective keyword
- Scenario 2: Desired keyword does not appear in suggestions
 - User selects the Other option and enters an alternate keyword
- Scenario 3: Selected keyword appears in transcription
 - The research results will return in the context of 20-50 words containing the keyword sorted in chronological order by default (other orderings can be selected above in the dashboard).
- Scenario 4: Selected keyword does not appear transcription
 - “Your query “[insert query]” did not yield any results” message will be displayed

Appendix

Technologies Employed:

React: Frontend elements, including audio streaming capabilities, powered by Twilio

Tailwind: Styling Frontend elements

AWS/DynamoDB: NoSQL Database for storing user info and sessions

AWS/Amplify: Backend REST API to communicate with Database

Jigsaw/Perspective API: Toxicity Scoring API to

AWS/Amazon Medical Comprehend: NLP service to extract information from transcripts

Auth0/Google OAuth: Authentication service to provide Role-Based Access Control