Preliminary Design Proposal

CS 205

Jackson Eshbaugh

Tuna Akin

Efe Civisiken

Eliso Morazara

I. Definition of Problem & Design Overview

Problem Definition: “So fundamentally we're dealing with a problem where the government doesn't know where the biggest [unintelligible] are which makes it hard to effectively provide services in the places they're needed.” (Groves).

Definition of Problem: In Tanzania, there exists a significant disconnect between the government and the citizens they serve, particularly in the healthcare system. This disconnect leads to a lack of accountability at all levels—from government officials to healthcare providers. As a result, healthcare services suffer, and citizens bear the consequences. Furthermore, the government lacks a clear understanding of how these services are performing, making it difficult to make informed decisions.

1. Design Overview

We propose a review platform to support accountability in public healthcare in Tanzania. This platform will be easily accessible (i.e., online), and will be fully compatible with smartphones. Citizens will be able to search for healthcare providers based on rankings derived from survey data, similar to consumer review platforms. For rural citizens, there will be features that generate reports summarizing key healthcare facility rankings, which can be printed, broadcasted on the radio, or presented at town meetings. To promote broader use, this platform will be multilingual, offering both English and Swahili versions.

In addition to survey data, the system will integrate other forms of feedback, such as government audits and news reports. The platform will also harness unsupervised machine learning techniques to improve data interpretability. These might include anomaly detection models to flag centers with abnormal data, sentiment analysis, and word-embedding techniques to process Swahili survey responses into a usable vector format.

Healthcare facilities will be assigned a score between 0 and 5 based on various factors, such as sentiment analysis of qualitative survey responses, average ratings (from rating questions), and a comparison of how these facilities perform relative to similar ones (based on k-means clustering). Scores are updated weekly, recalculated as new survey data is added to the system. We now explore the system from different perspectives.

3.1. User Perspective

The *user perspective* pertains to how users interact with the system. We elaborate on user perspectives based on cases:

- *Citizens* — Citizens are able to access the platform without credentials. Their use of the service will primarily include searching for healthcare facilities and viewing summary data about them. For example, citizens can search for a facility, view statistics such as an overall score and the average response to some of the more important ranking questions, and compare that facility to others.

    - *Citizens in rural communities* — As a special case, citizens in rural areas will be able to engage with this data in ways that may not require a device or an internet connection. For example, a document that lists the top 5 or 10 best and worst healthcare facilities in a given region would be useful to many entities. Radio stations could broadcast this information, and mayors could include it in their town meetings.
- *Healthcare providers* — Healthcare providers are able to access more detailed information about their specific facilities. While feedback will remain anonymous, healthcare providers will be able to access average responses to each survey question, along with high-level recommendations of where to target reform (in the form of a list of strengths and weaknesses).
- *Public officials* — Public officials are almost identical to healthcare providers: they can view the same information that healthcare providers can, but they can do this for a defined jurisdiction (similar to a government official). They also have an anomaly detection dashboard, which flags facilities with unusual patterns in survey responses.
- *Government officials* — Government officials access all public official data plus anonymous individual responses. They too have the anomaly detection dashboard mentioned above.
- *System administrators* — Admins are the most privileged users of the system. They are responsible for creating and managing user accounts, ensuring access for authorized users. Alongside being able to view each of the views from less privileged users, administrators can also view every feedback response recorded, *including contact information*, which provides the potential for follow-up.

3.2 Structural Perspective

3.2.1 Data Pipeline

The data flow in the system is as follows:

1. Import survey data from CSV files (and any other types of reports & data if they are supported by the system)
2. Machine learning techniques are applied to increase the interpretability of the data.
    a. According to Groves, the "government doesn't know where the biggest" needs are. He also discussed how too much information "might lead to information overload."
        i. To resolve this problem, we utilize ML techniques to increase the interpretability of the data.
    b. Models may include: anomaly detection, k-means clustering, sentiment analysis, and more
    c. Results can be used to add other features to the system, such as a listing of outlier healthcare facilities for government officials, a listing of similar facilities, or an overall sentiment for each facility (this could take into account other text-based reports & data).
3. Data is analyzed and scored on a scale from 0–5 based on:
    a. *Baseline Score:* Average ratings from the survey
    b. *Adjustment Factors:* Perhaps ML results may be included (i.e., sentiment analysis may play a role in this score)

This flow occurs once per week, since data is delivered once per week. Also, data is never overwritten. Instead, everything is saved so that previous statistics can be viewed.

3.2.2 User Interaction & Accessibility

Users should be able to interact with the system easily. This means that the system *must* support mobile devices and Swahili. Additionally, summarized reports can be exported as printable documents, which can then be disseminated through town meetings, radio broadcasts, and more. The high level user roles and permissions are listed below.

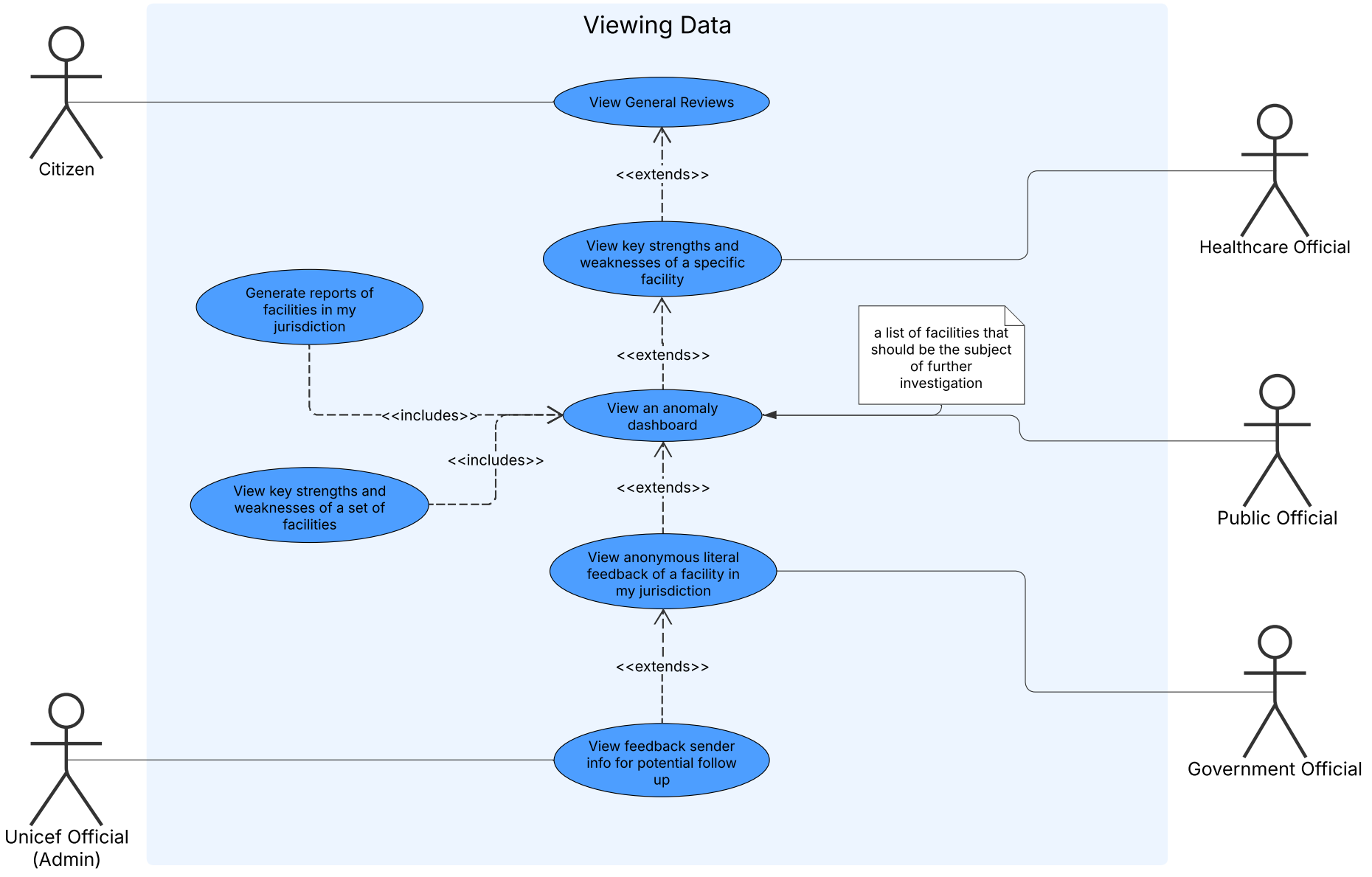
- *Citizens (unauthenticated)* access public reports & rankings.
- *Healthcare providers* review anonymized facility-specific feedback.
- *Public officials* analyze comparative facility reports within their jurisdiction.
- *Government officials* gain access to raw anonymous survey data and anomaly detection insights.
- *System administrators* manage user accounts and oversee platform operations.

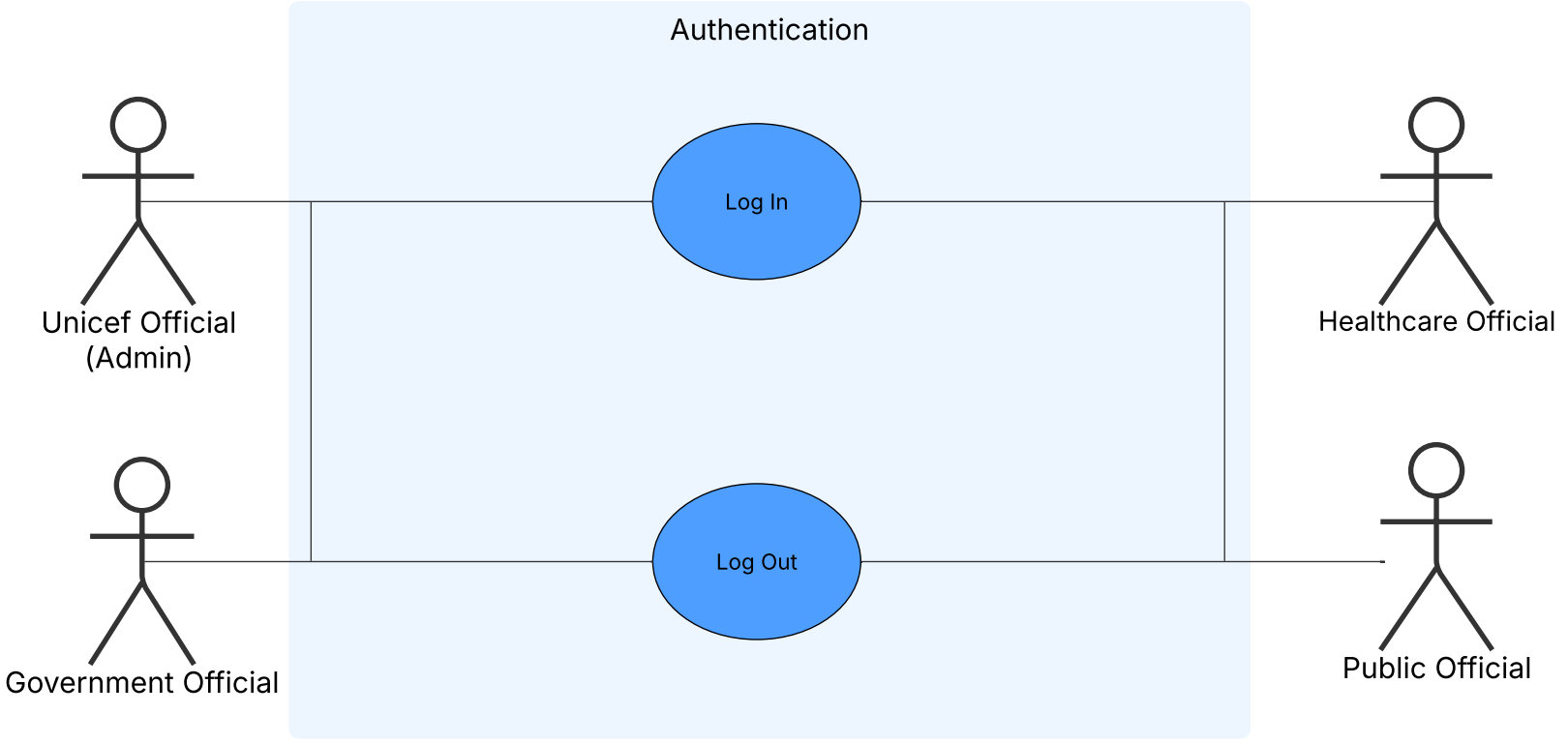
3.3. Key Features

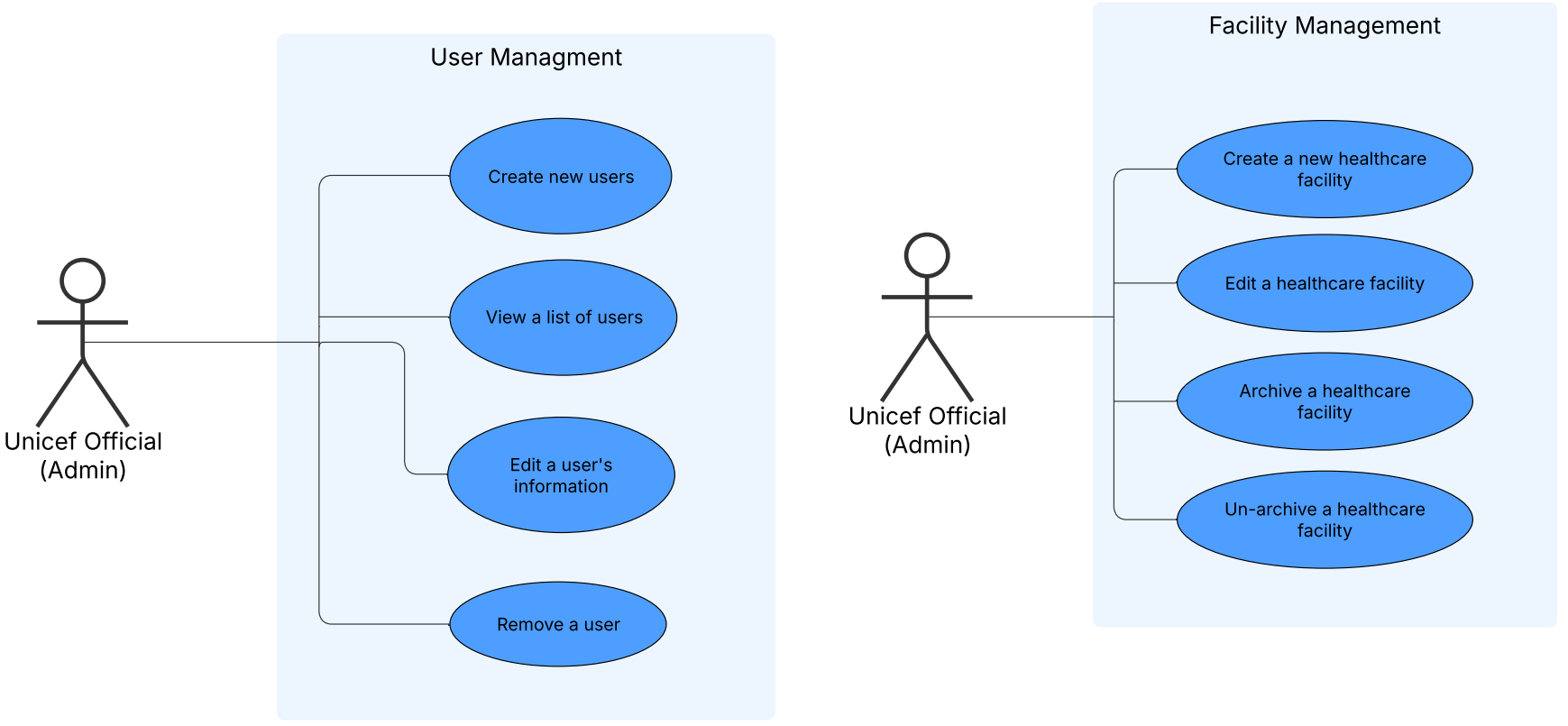
Our solution will harness the power of machine learning techniques to improve the interpretability of data, such as anomaly detection for detecting outlying medical facilities. Additionally, we plan to support other types of data, such as news reports or government audits of facilities, parsing and analyzing these using sentiment analysis to provide a more complete evaluation of healthcare facilities.

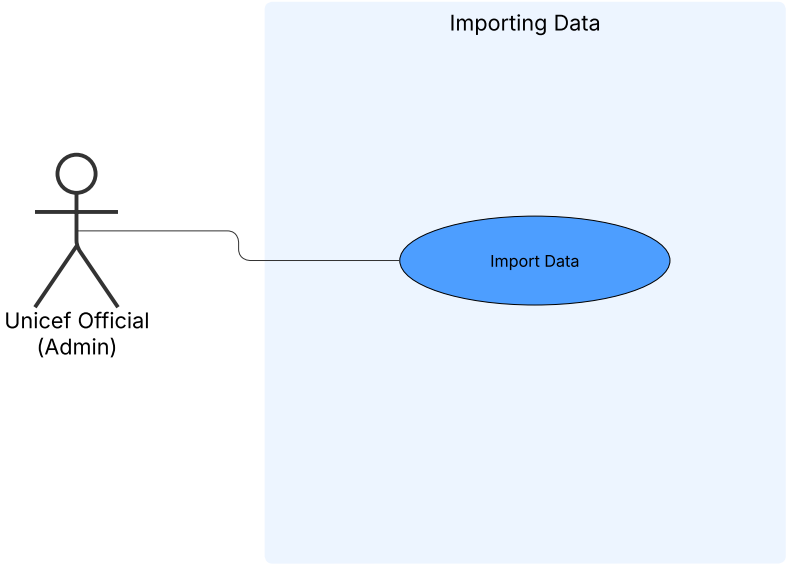
3.4 Use Case Diagram

On the following pages is a use case diagram, outlining the use cases of the system.


Viewing Data
Citizen
View General Reviews
<<extends>>
View key strengths and weaknesses of a specific facility
Healthcare Official
Generate reports of facilities in my jurisdiction
<<extends>>
a list of facilities that should be the subject of further investigation
<<includes>>
View an anomaly dashboard
Public Official
<<includes>>
View key strengths and weaknesses of a set of facilities
<<extends>>
View anonymous literal feedback of a facility in my jurisdiction
<<extends>>
Government Official
Unicef Official (Admin)
View feedback sender info for potential follow up


Authentication
Log In
Log Out
Unicef Official
(Admin)
Government Official
Healthcare Official
Public Official


User Managment
Create new users
View a list of users
Edit a user's information
Remove a user
Unicef Official (Admin)
Facility Management
Create a new healthcare facility
Edit a healthcare facility
Archive a healthcare facility
Un-archive a healthcare facility
Unicef Official (Admin)


Importing Data
Import Data
Unicef Official
(Admin)

II. User Stories

Priority	As a …	I want to …
1 [highest]	Citizen	Access health facility reviews and ratings within my community so that I can make an educated decision on where to seek care.
3		Provide real-time feedback for emergency issues (e.g. facility closure or stock-out) so that others in my community are aware.
1		Maintain anonymity when submitting sensitive feedback so I can report issues without fear of retaliation.
2		Access the platform in both English and Swahili so I can provide feedback in my preferred language.
3		Receive updates when my reported issues are addressed so I know my feedback led to action.
2		Get information about local health facilities even without access to a computer or smartphone so that I can make informed decisions about where to seek care regardless of how connected I am.
2		Compare two or more healthcare facilities so I can easily make a decision about which to visit for my next appointment.
2		View historical data to see if improvements have been made in my local healthcare centers so I can be better informed about my healthcare centers.
1	Healthcare Facility Staff Member	View collected feedback on my facility so I can understand areas for improvement.
		Post updates on the facility page to inform and engage the community

2		Track changes in the feedback over time so I can see if improvements or regressions are made in facility operation.
1	Public Official	View healthcare facilities in my area of focus so I can identify facilities that need attention and support improvement efforts.
3		Generate summary reports on healthcare facility performance in my area of focus, so I can easily share key insights with other officials and stakeholders
2		Compare facilities in my area of focus, so I can identify which are performing well and which need improvement or intervention.
3		View a summary dashboard of “anomaly” cases, healthcare facilities in my jurisdiction that have been flagged as outliers.
1	Government Official	View data about healthcare facilities in my area of governance so I can find any issues in the healthcare system.
3		View a summary dashboard of “anomaly” cases, healthcare facilities in my jurisdiction that have been flagged as outliers.
2		Determine how well my area of governance is doing in terms of provision of healthcare so I can be encouraged to work towards a better public healthcare system.
2		Access historical healthcare facility feedback data so I can identify trends and make long term policy decisions.
3		Generate summary reports on healthcare facility performance in my jurisdiction, so I can easily share key insights with other government officials and stakeholders
1	System Administrator	Create an account for a new official or healthcare provider so that they can access data relevant to their jurisdiction.

1		Delete an account for a healthcare provider or government official so that if they leave their position or something similar, their access to this data can be restricted.
1		Update an account's details so a government official or healthcare provider can maintain access to their accounts even if some details are forgotten, or so that accurate, up-to-date information about each user is maintained.
2		Create a new healthcare facility so newly opened facilities can also be tracked by the system.
2		Edit a healthcare facility's details so changes in information can be recorded.
2		Archive a healthcare facility so facilities that close can be marked as such. *Note: deleting data seems irresponsible, so we only mark facilities as archived*.
1		Upload CSV files through a web interface so the contents inside can be imported into the system.
2		Upload CSV files through a RESTful API so the contents inside can be imported into the system, automatically.
2		Filter data when uploaded from CSV files (using whichever mechanism) so that duplicate responses will not be considered in the system.

III. Use Case Descriptions

Use Case: View General Reviews of a Facility	**ID:** 0	**Importance:** high

Primary Actor: Citizens	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Citizen — wants to view general data for a specific facility
Brief Description: Describes how general review information is disseminated publicly to the citizens of Tanzania
Trigger: Citizen selects a specific facility to conduct a closer review **Type:** External
Relationships: **Association:** Citizen **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The Citizen specifies a facility to view. 2. The review display is prepared. 3. The facility's data is displayed, including the aggregated 5-point-scale score, average responses to some survey questions, and the sentiment score.
Sub-Flows: N/a
Alternate/Exception Flows: N/a

Use Case: View Key Strengths and Weaknesses of a Facility	**ID:** 1	**Importance:** high

Primary Actor: Healthcare Professionals	**Use Case Type:** Detail, Essential

Stakeholders & Interests:
Healthcare Professional — wants to view key strengths and weaknesses of his/her specific facility
Public Official / Government Official — wants to view key strengths and weaknesses of a facility in his/her jurisdiction

Brief Description: Describes how specific users can view more complete data (key strengths and weaknesses) of a specific facility.

Trigger: Citizen selects a specific facility to conduct a closer review.

Type: External

Relationships:
Association: Healthcare Professionals
Include:

Extend: View General Reviews of a Facility
Generalization:

Normal Flow of Events:
1. The user specifies a facility to view.
2. The review display is prepared.
3. The facility's data is displayed, including general review data and a breakdown of average responses to each survey question.

Sub-Flows: N/a

Alternate/Exception Flows:
2a1. If the user is not logged in, the system displays an error message.
2a2. If the user does not have permission to view a facility at this level, the system displays an error message.

Use Case: Generate reports of facilities in my jurisdiction	**ID:** 2	**Importance:** medium

Primary Actor: Public Officials, Government Officials	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Public Official & Government Official — wants to generate automatic reports on all facilities in his/her jurisdiction
Brief Description: Describes how certain users can export reports concerning all facilities in their jurisdictions.
Trigger: The official selects to generate a report of all facilities in his/her jurisdiction **Type:** External
Relationships: **Association:** Public Officials, Government Officials **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The system gathers all facilities in the user's jurisdiction. 2. The user specifies the number of facilities to include on the report. 3. Facilities are filtered based on the given numbers to get the top *n* and bottom *m* facilities 4. A PDF is generated containing this information. 5. The user downloads the PDF.
Sub-Flows: N/a
Alternate/Exception Flows: 1a. If the user is not logged in, the system displays an error message.

Use Case: View key strengths and weaknesses of a set of facilities	**ID:** 3	**Importance:** high

Primary Actor: Public Officials, Government Officials	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Public Official & Government Official — wants to generate automatic reports of key strengths and weaknesses on a specific set of facilities inside one's jurisdiction.
Brief Description: Describes how certain users can view key strengths and weaknesses of a set of facilities (typically within their jurisdiction)
Trigger: The official selects a set of facilities. **Type:** External
Relationships: **Association:** Public Officials, Government Officials **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The user specifies the list of facilities to view. 2. The review display is prepared. 3. The facility's data is displayed, including general review data and a breakdown of average responses to each survey question, for each facility.
Sub-Flows: N/a
Alternate/Exception Flows: 1a1. If the user is not logged in, the system displays an error message. 2a1. If the user does not have permission to view a facility in the set at this level, the system displays an error message.

Use Case: View an anomaly dashboard	**ID:** 4	**Importance:** high

Primary Actor: Public Officials, Government Officials	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Public Official — wants to generate automatic reports on all facilities in his/her jurisdiction
Brief Description: Describes how certain users can view a dashboard consisting of outlying facilities, where investigation is likely necessary.
Trigger: The official goes to his/her jurisdiction dashboard **Type:** External
Relationships: **Association:** Public Officials **Include:** Generate reports of facilities in my jurisdiction, View key strengths and weaknesses of a set of facilities **Extend:** View Key Strengths and Weaknesses of a Facility **Generalization:**
Normal Flow of Events: 1. The system prepares an anomaly list with only user-accessible facilities. 2. This dashboard is displayed.
Sub-Flows: N/a
Alternate/Exception Flows: 1a. If the user is not a government official, public official, or an admin, the system displays an error message.

Use Case: View anonymous literal feedback of a facility in my jurisdiction	**ID:** 5	**Importance:** high

Primary Actor: Government Officials	**Use Case Type:** Detail, Essential

Stakeholders & Interests:
Government officials — need the ability to look at literal feedback to understand specific cases of bad performances and make decisions for improvement.

Brief Description: View literal feedback data line-by-line for a given facility.

Trigger: The user selects a facility and opts to view literal feedback.

Type: External

Relationships:
Association: Government Officials
Include:

Extend: View an anomaly dashboard
Generalization:

Normal Flow of Events:
1. The user specifies a facility to view.
2. The system fetches the list of feedback for the given facility.
3. The facility's data is displayed, with each feedback index viewable on its own in extreme detail.

Sub-Flows: N/a

Alternate/Exception Flows:
1a1. If the user is not logged in, the system displays an error message.
2a2. If the user does not have permission to view a facility at this level, the system displays an error message.

Use Case: View feedback sender info for potential follow up	**ID:** 6	**Importance:** high

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Admin — needs the ability to view feedback sender personal data for potential follow up
Brief Description: View feedback sender contact information and names
Trigger: Click on a case that triggered a big red flag **Type:** External
Relationships: **Association:** Administrator **Include:** **Extend:** View anonymous literal feedback of a facility in my jurisdiction **Generalization:**
Normal Flow of Events: 1. As part of the whole interface, each highlighted feedback in any pages will also show the sender's names besides the literals 2. When they click on that feedback, they can also find their contact info.
Sub-Flows: N/a
Alternate/Exception Flows: 2a1. If the user is not logged in, the system displays an error message. 2a2. If the user does not have permission to view a facility at this level, the system displays an error message.

Use Case: Log In	**ID:** 7	**Importance:** high

Primary Actor: All account-bearing users	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Account-bearers — need to be able to prove they are who they say they are so that permissions can be granted to them on the system
Brief Description: Describes the process of logging into the system.
Trigger: User selects to log in. **Type:** External
Relationships: **Association:** Healthcare Professional, Public Official, Government Official, Admin **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. User provides email and password. 2. The user is redirected to the homepage, now logged in.
Sub-Flows: N/a
Alternate/Exception Flows: 1a1. If the email or password is invalid, the system displays an error message.

Use Case: Log Out	**ID:** 8	**Importance:** high

Primary Actor: All account-bearing users	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Account-bearers — need to be able to log out to protect the integrity of the data on the system.
Brief Description: Describes the process of logging out of the system.
Trigger: User selects to log out. **Type:** External
Relationships: **Association:** Healthcare Professional, Public Official, Government Official, Admin **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The user is logged out of the system. 2. The user is redirected to the home page.
Sub-Flows: N/a
Alternate/Exception Flows: 1a1. If the user is logged in, this action is ignored and the user is redirected to the home page.

Use Case: Import Data	**ID:** 9	**Importance:** high

Primary Actor: Administrator	**Use Case Type:** Detail, Essential

Stakeholders & Interests:
Administrator — Want to upload new data for use in the system.

Brief Description: Describes how new data can be uploaded into the system.

Trigger: Administrator has new data that they want to upload.

Type: External

Relationships:
Association: Admin
Include:

Extend:
Generalization:

Normal Flow of Events:
1. The user selects an upload method.
   If the upload method is RESTful API, the S-1 subroutine is performed.
   If the upload method is web-based, the S-2 subroutine is performed.
2. The type of data is specified.
   If the data uploaded was facility review data, the S-3 subroutine is performed.
   If the data uploaded was supporting textual data, the S-4 subroutine is performed.

Sub-Flows:
S-1: RESTful API Upload
1. The user uploads the data via a RESTful API.

S-2: Web-based Upload
1. The user selects the file to upload
2. The file is uploaded.

S-3: Facility Review Data
1. The system removes any duplicate data from this uploaded data.
2. The new data is run through ML algorithms fine-tuned to process facility review data.

S-4: Supporting Textual Data
1. The new data is run through ML algorithms fine-tuned to process supporting textual data.

Alternate/Exception Flows:
1a1. If the user is not an administrator, the system displays an error.

Use Case: List Users	**ID:** 10	**Importance:** medium

Primary Actor: Administrator	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Administrators — Want to view a list of users in the system for easier moderation.
Brief Description: Describes how current users in the system are listed.
Trigger: Administrator needs to determine which users are in the system. **Type:** External
Relationships: **Association:** Admin **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The user specifies any *(optional)* filtering criteria for the list. 2. The system prepares the list of users based on those criteria. 3. The list is then displayed to the user.
Sub-Flows: N/a
Alternate/Exception Flows: 1a1. If the user is not an administrator, the system displays an error.

Use Case: Create New Users	**ID:** 11	**Importance:** high

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests:
Unicef Official (Admin) – Needs to add new users to the system for management purposes.

Brief Description: Describes how an admin creates new user accounts in the system.

Trigger: The admin initiates the user creation process.

Type: Internal

Relationships:

Association: Unicef Official (Admin)
Include:

Extend:
Generalization:

Normal Flow of Events:

1. The admin selects the option to create a new user.
2. The system prompts for necessary user details (e.g., name, email, role).
3. The admin enters the details and submits the request.
4. The system validates the information and creates the user account.
5. A confirmation message is displayed, and the new user is notified.

Sub-Flows: N/A

Alternate/Exception Flows:
1a1. If required information is missing, the system prompts the admin to complete the fields.

Use Case: Edit a User's Information	**ID:** 12	**Importance:** Medium

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Unicef Official (Admin) – Needs to update user information for accuracy and administrative purposes.
Brief Description: Describes how an admin updates a user's information.
Trigger: The admin selects a user to update their details. **Type:** Internal
Relationships: **Association:** Unicef Official (Admin) **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The admin selects a user from the list. 2. The system displays the user's current details. 3. The admin updates the required fields. 4. The system validates and saves the changes. 5. A confirmation message is displayed.
Sub-Flows: N/A
Alternate/Exception Flows: 1a1. If validation fails, the system prompts the admin to either correct the data or return to the previous state.

Use Case: Remove a User	**ID:** 13	**Importance:** high

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Unicef Official (Admin) – Needs to remove inactive or unauthorized users.
Brief Description: Describes how an admin removes a user from the system.
Trigger: The admin selects a user for removal. **Type:** Internal
Relationships: **Association:** Unicef Official (Admin) **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The admin selects a user from the list. 2. The system asks for confirmation before proceeding. 3. The admin confirms the removal. 4. The system deletes the user and displays a confirmation message.
Sub-Flows: N/A
Alternate/Exception Flows: 1a1. If the user has active tasks, the system prevents deletion and notifies the admin.

Use Case: Create a New Healthcare Facility	**ID:** 14	**Importance:** high

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Unicef Official (Admin) – Needs to add new healthcare facilities to the system.
Brief Description: Describes how an admin adds a new healthcare facility to the system.
Trigger: The admin initiates the facility creation process. **Type:** Internal
Relationships: **Association:** Unicef Official (Admin) **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The admin selects the option to add a new facility. 2. The system prompts for facility details (name, location, capacity, etc.). 3. The admin fills in the details and submits the request. 4. The system validates the data and creates the facility. 5. A confirmation message is displayed.
Sub-Flows: N/A
Alternate/Exception Flows: 1a1. If required details are missing, the system prompts the admin to complete them or gives an option to cancel the creation of the facility.

Use Case: Edit a Healthcare Facility	**ID:** 15	**Importance:** Medium

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Unicef Official (Admin) – Needs to update facility details for accuracy.
Brief Description: Describes how an admin updates the details of a healthcare facility.
Trigger: The admin selects a facility for modification. **Type:** Internal
Relationships: **Association:** Unicef Official (Admin) **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The admin selects a facility. 2. The system displays the current details. 3. The admin updates the necessary fields. 4. The system validates and saves the changes. 5. A confirmation message is displayed.
Sub-Flows: N/A
Alternate/Exception Flows: 1a1. If validation fails, the system prompts the admin to correct the data.

Use Case: Archive a Healthcare Facility	**ID:** 16	**Importance:** Medium

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests: Unicef Official (Admin) – Needs to manage inactive or closed facilities.
Brief Description: Describes how an admin archives a healthcare facility.
Trigger: The admin selects a facility for archival. **Type:** Internal
Relationships: **Association:** Unicef Official (Admin) **Include:** **Extend:** **Generalization:**
Normal Flow of Events: 1. The admin selects a facility. 2. The system prompts for confirmation before proceeding. 3. The admin confirms the archival. 4. The system marks the facility as archived. 5. A confirmation message is displayed.
Sub-Flows: N/A
Alternate/Exception Flows: 1a1. If the facility has active cases, the system prevents archival and notifies the admin.

Use Case: Un-Archive a Healthcare Facility	**ID:** 17	**Importance:** Medium

Primary Actor: Unicef Official (Admin)	**Use Case Type:** Detail, Essential

Stakeholders & Interests:
Unicef Official (Admin) – Needs to restore previously archived facilities.

Brief Description: Describes how an admin restores an archived healthcare facility.

Trigger: The admin selects an archived facility to reactivate.

Type: Internal

Relationships:
Association: Unicef Official (Admin)
Include:

Extend:
Generalization:

Normal Flow of Events:
1. The admin selects an archived facility.
2. The system prompts for confirmation.
3. The admin confirms the restoration.
4. The system marks the facility as active.
5. A confirmation message is displayed.

Sub-Flows: N/A

Alternate/Exception Flows:
1a1. If the facility is outdated, the system may require re-verification before activation.

IV. Major System Components (Features)

1. Facility Search & Review Access

Citizens can find healthcare facilities where they will be treated fairly and where they will get quality service.

- General review information is publicly available to all citizens who engage with the platform.
- Users can search for facilities and review high-level data about them to inform their healthcare decisions.
    - Primarily, a 5-point-scale score is used to summarize a facility's performance. This is informed by numerous data points, and by machine learning (i.e., sentiment analysis).

2. Detailed Facility Analytical Data Visualization

More detailed data is provided to (1) facility staff so they can improve their services, (2) government and public officials so they can oversee and improve services at facilities, and (3) administrators so they can possibly follow-up with respondents.

- Healthcare professionals can view aggregated analytical data for their facility. Their facility's details can also be downloaded in PDF format.
- Government officials & public officials can view aggregated analytical data for facilities in their jurisdictions. Any one facility's details can be downloaded in PDF format, and any one report can be downloaded as a PDF. Reports for different regions within and including their jurisdiction can be generated in PDF format, which rank facilities by their score in a top *n* best and top *n* worst type of listing.
- Additionally, government officials & public officials can view an anomaly dashboard powered by an anomaly detection ML algorithm that shows any facilities that are outliers and should be reviewed. This dashboard is PDF-exportable.
- Administrators can view all data points for all facilities. Reports for different regions (including the whole country) can be generated in PDF format, which rank facilities by their score in a top *n* best and top *n* worst type of listing. They can additionally view contact information for the purposes of follow-up. Any one facility's details can be downloaded in PDF format, and any one report can be downloaded as a PDF *(optionally including contact information)*.

3. User Accounts

Any user who has permission to view more than is publicly available does so using a user account.

- All types of users can take two actions in the realm of accounts:
    - Users can log in, or validate their identity. This is done using a password check.
    - Users can log out, terminating their session. This is essential to prevent data leaks.
        - A user's session times out after a period of inactivity, to help ensure that the system remains secure.
- Administrators manage user accounts, including account creation, deletion, and updating any account details that need to be changed.

4. Facility Management

Administrators manage facilities, including adding new ones, archiving ones that have closed, and updating details.

- Administrators create new facilities in the system as they are added to the program. They also edit these facilities as information changes, and they archive facilities when they close. In case a facility were to re-open (or one were archived accidentally), administrators can also unarchive a facility.
    - *Note: Facilities are not deleted in order to maintain transparency.*

5. Importing Data

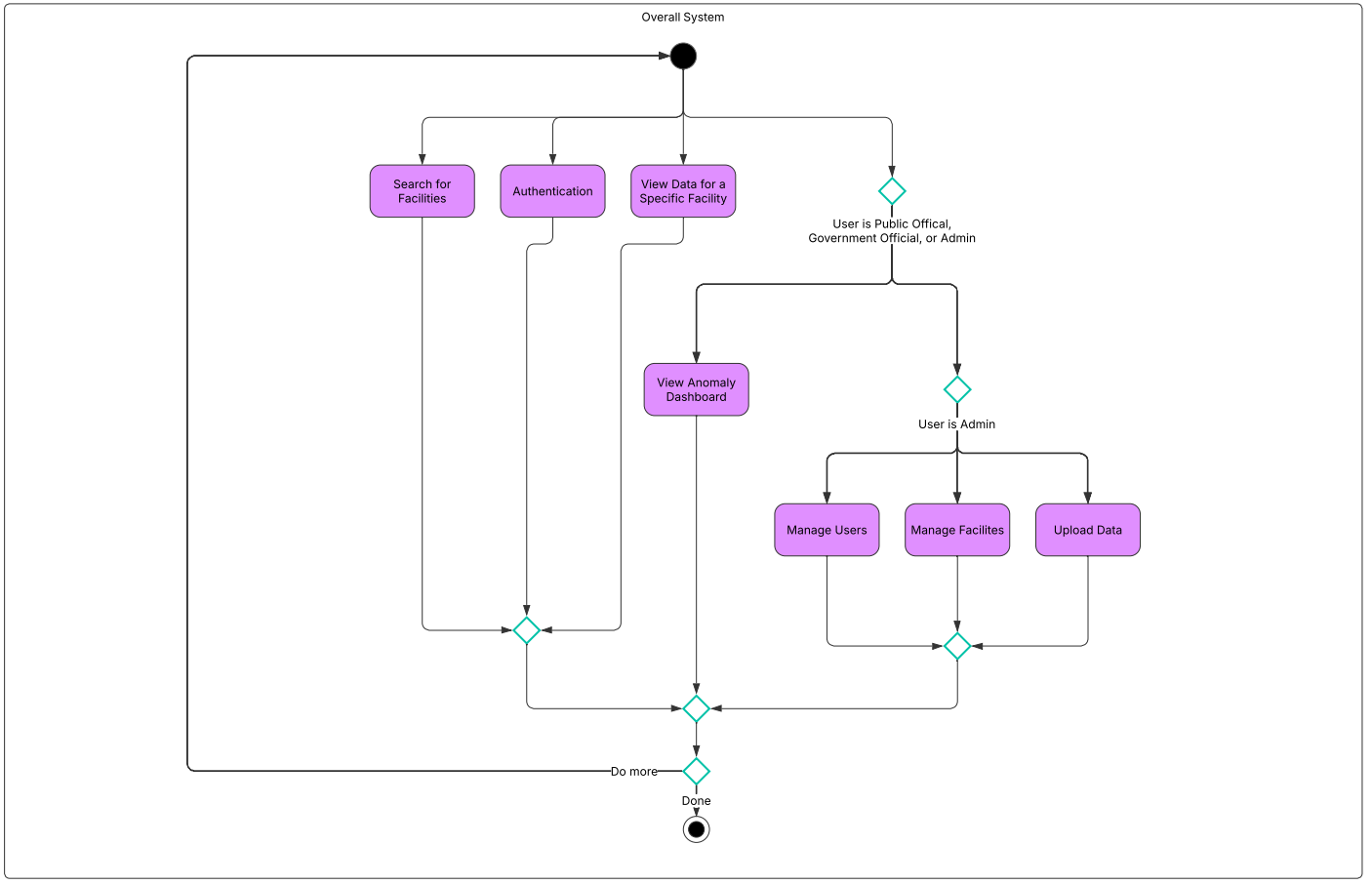
Administrators import two types of data—reviews from the phone survey and secondary textual feedback—into the system in two ways: via RESTful API or via a web-based upload.

- Administrators import reviews from the phone survey in CSV format via a RESTful API or a web-based file upload.
- Administrators import other forms of textual feedback:
    - *in text-file format* via RESTful API or web-based file upload
    - *as text alone* via copy-and-paste into a text box on a webpage

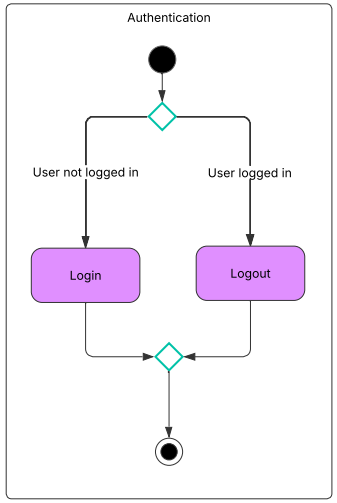
V. Process View

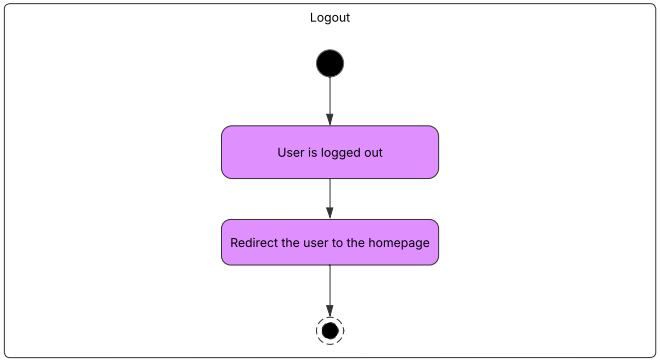
On the following pages are numerous activity diagrams that correspond to use cases of the system.

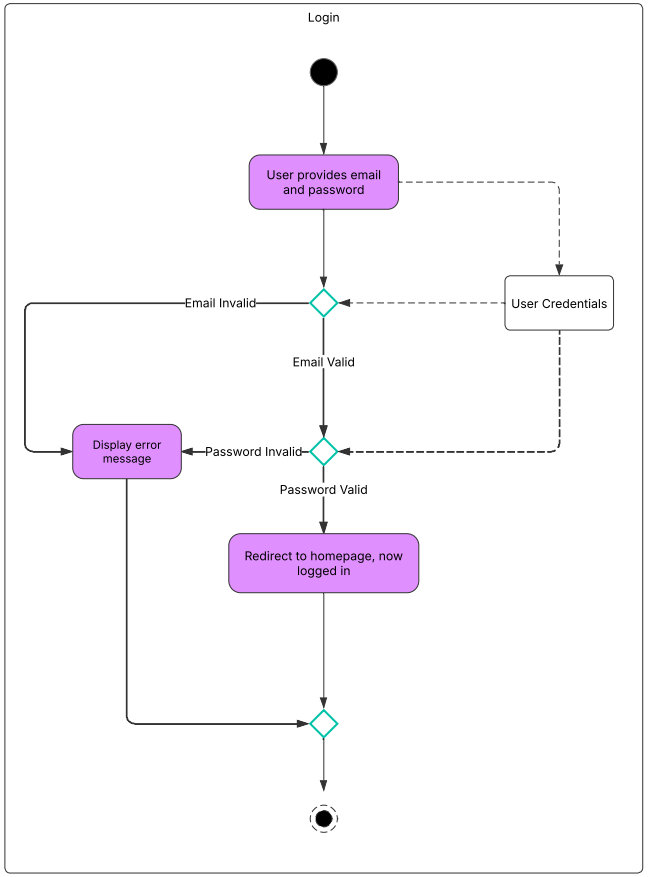
Overall System Flow



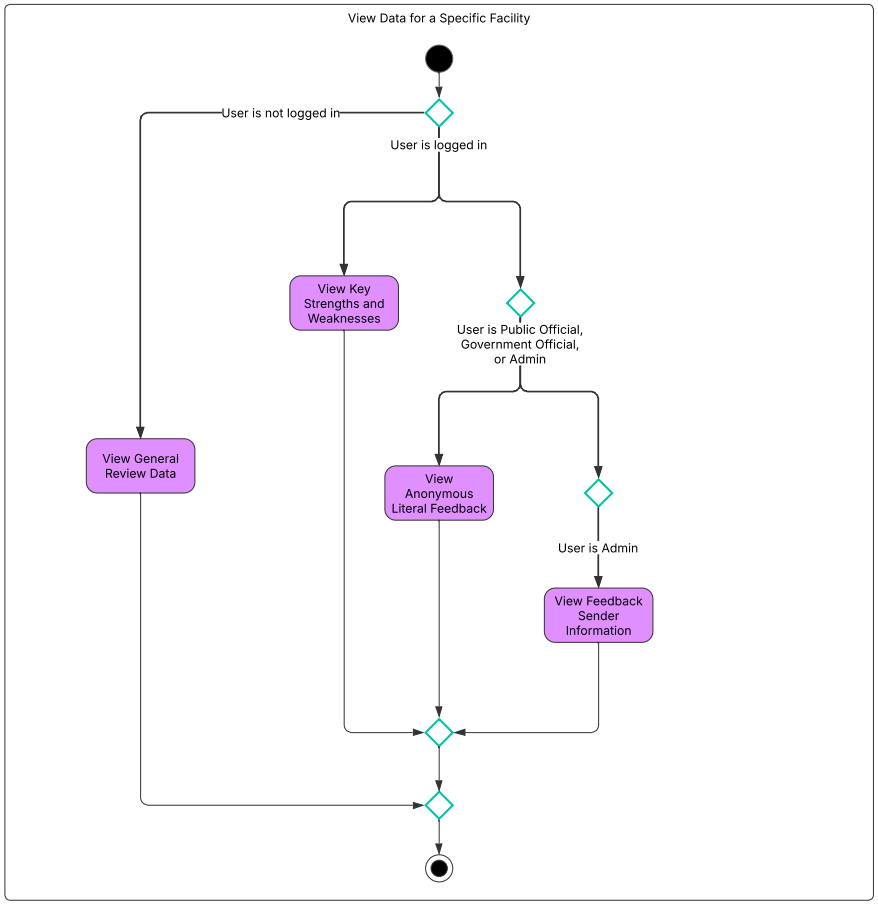
User Authentication





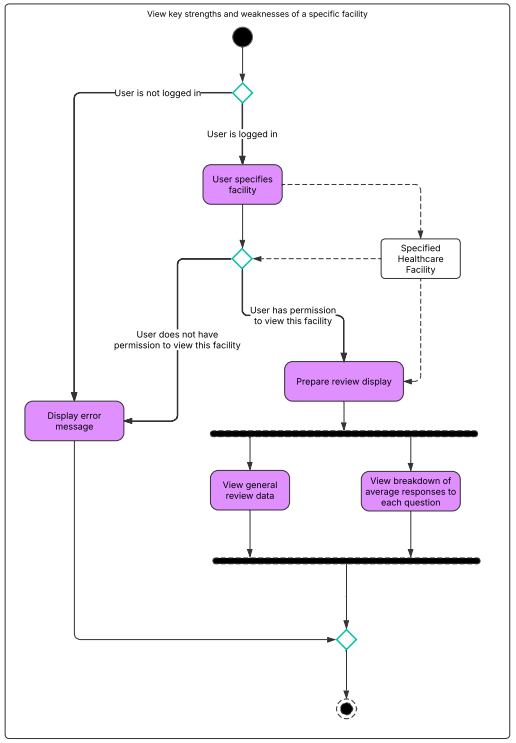


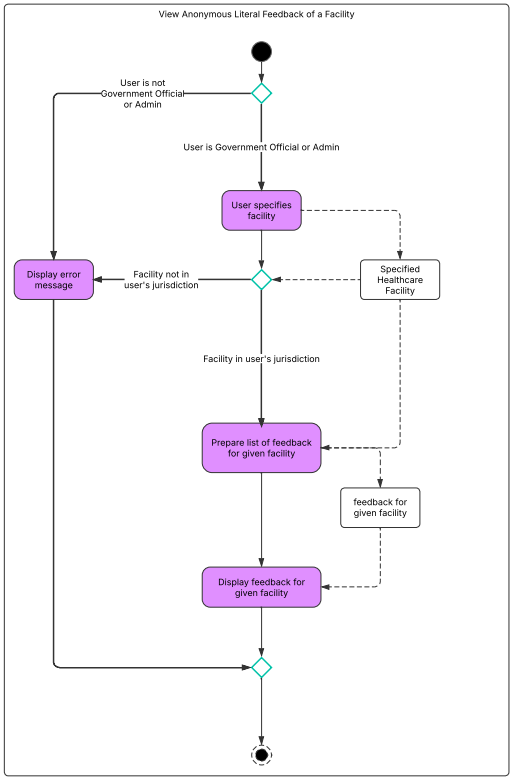
Viewing Data for a Specific Facility

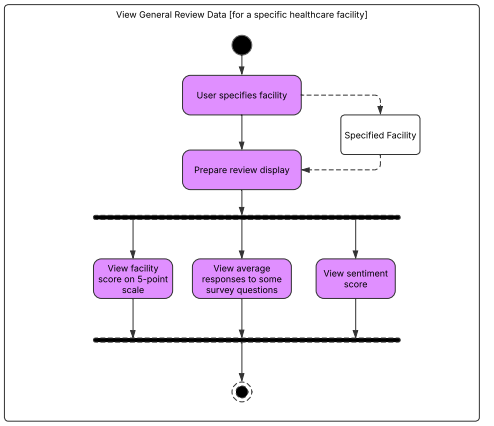


Viewing Data for a Specific Facility

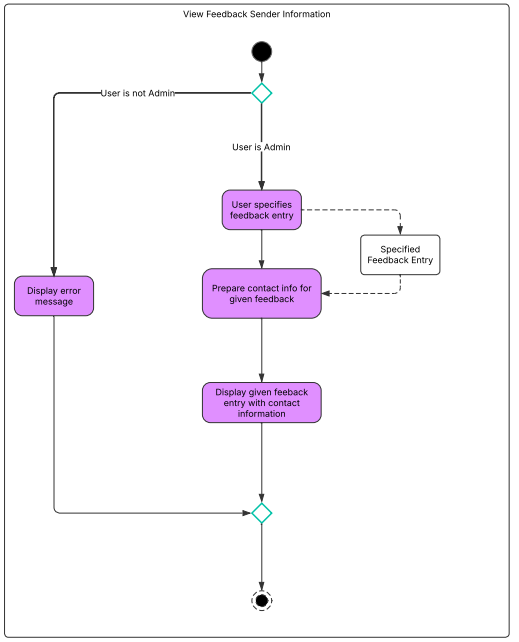
(cont'd)



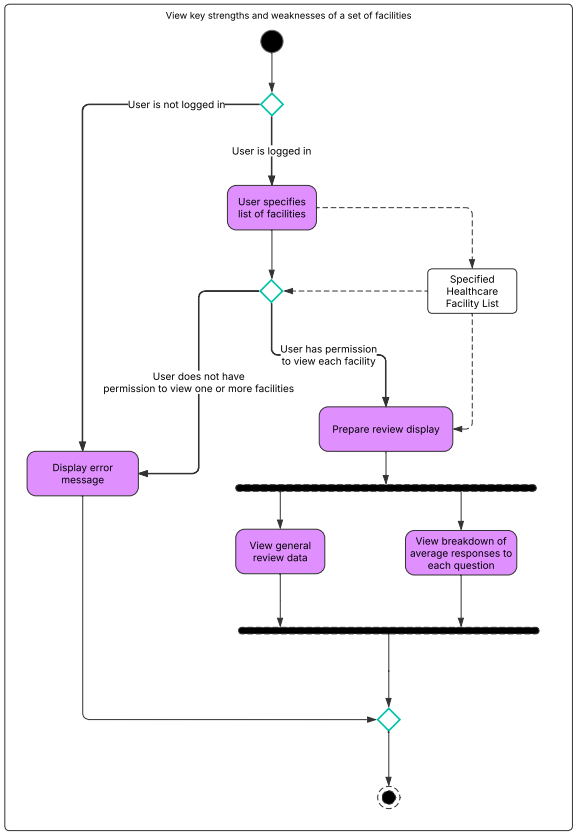




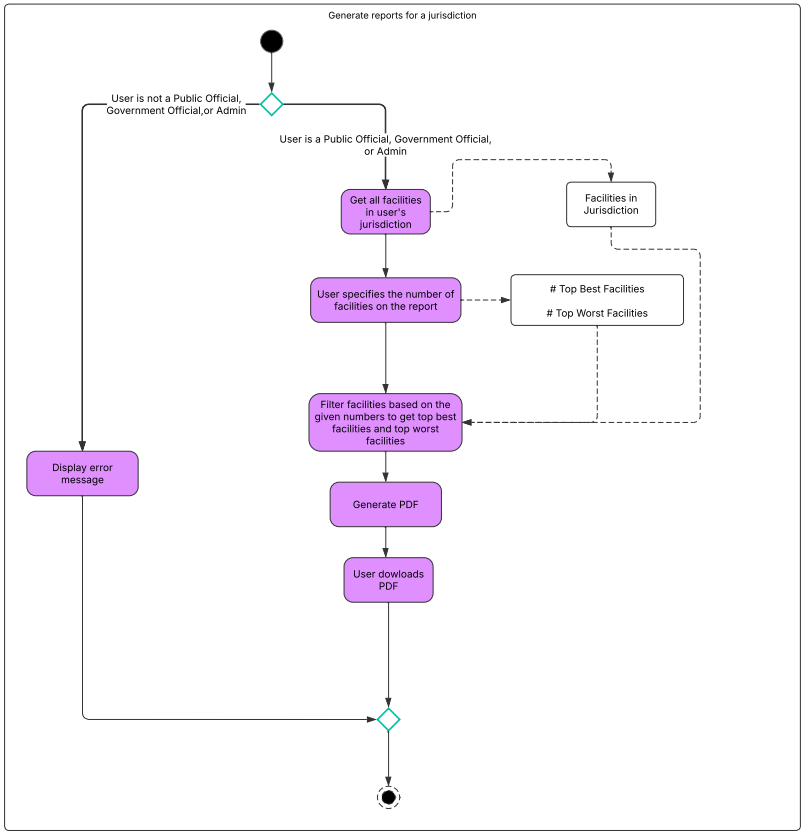
Text



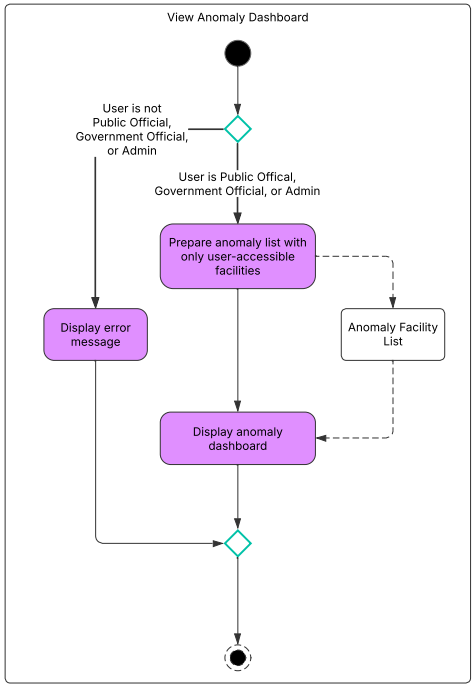
Viewing Data for a Set of Facilities



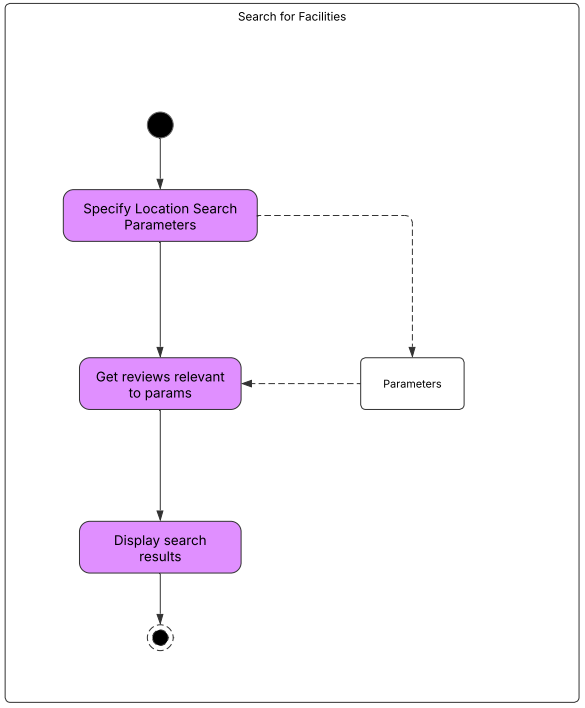
Generating Reports for a Jurisdiction



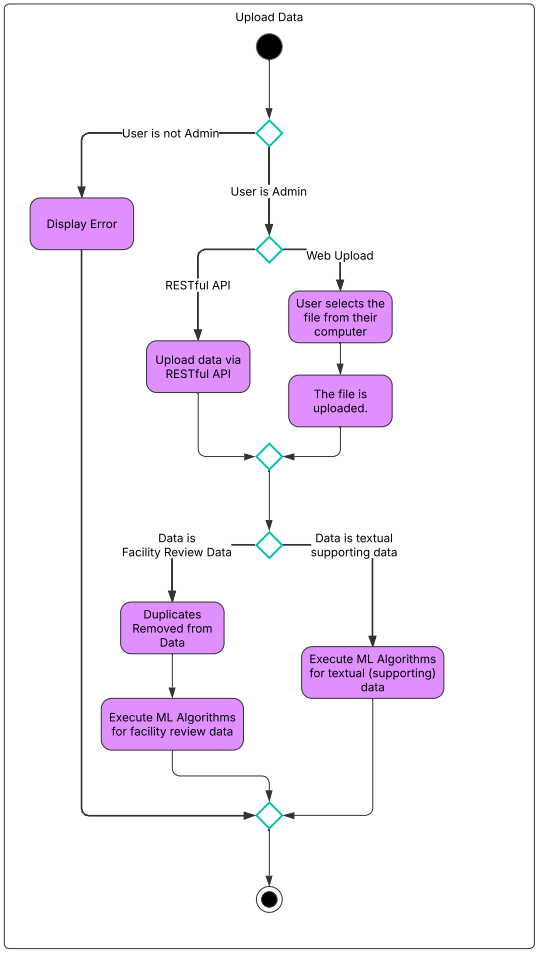
Anomaly Dashboard



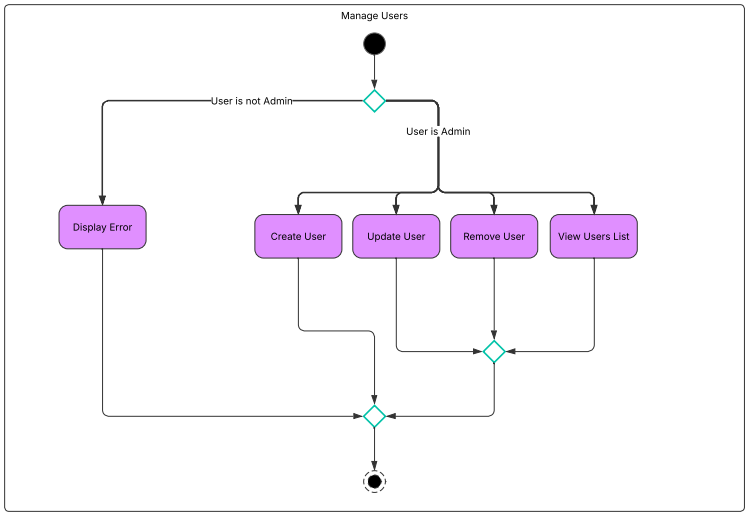
Search for Facilities

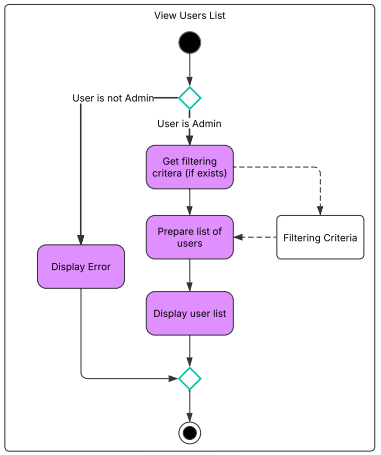


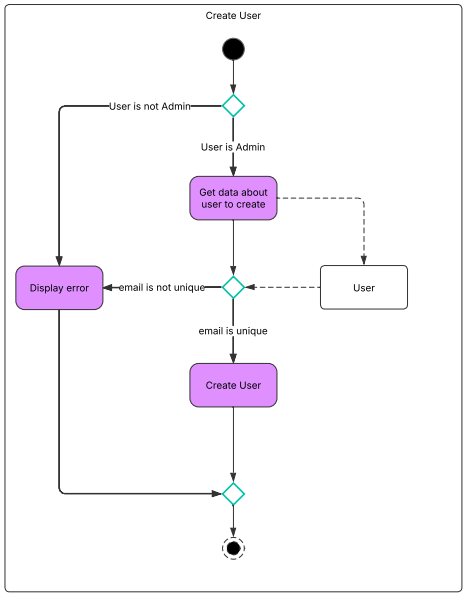
Upload Data

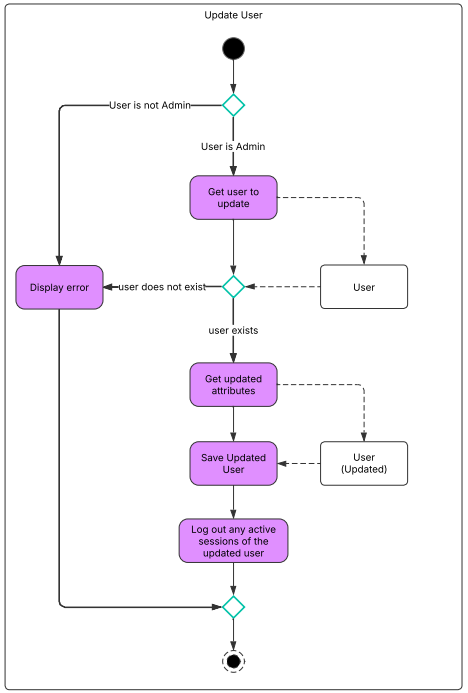


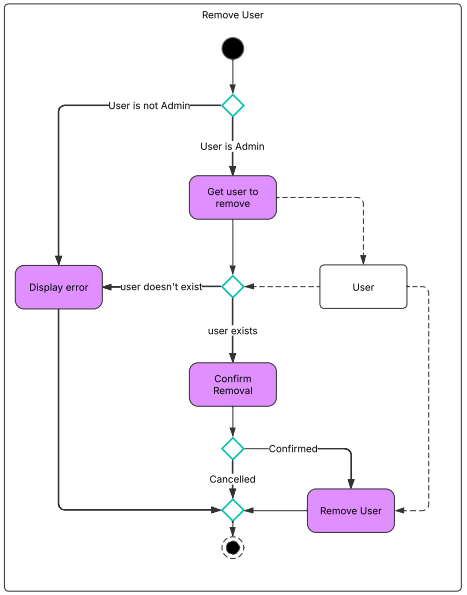
User Management



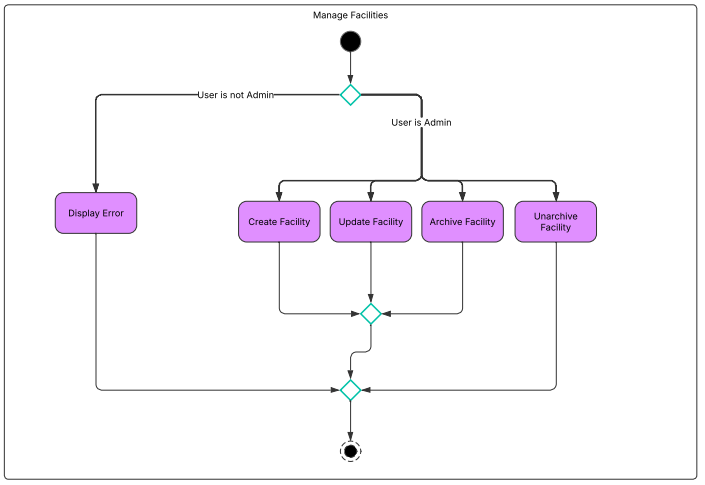


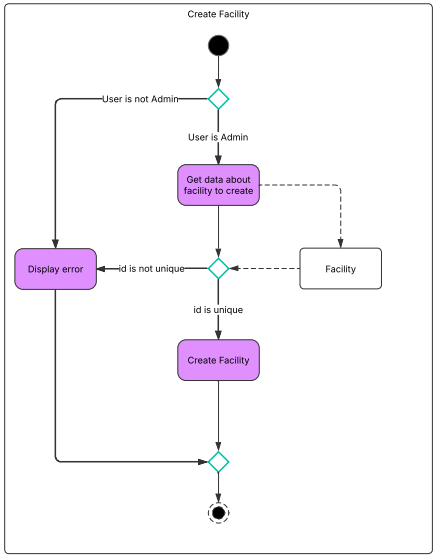


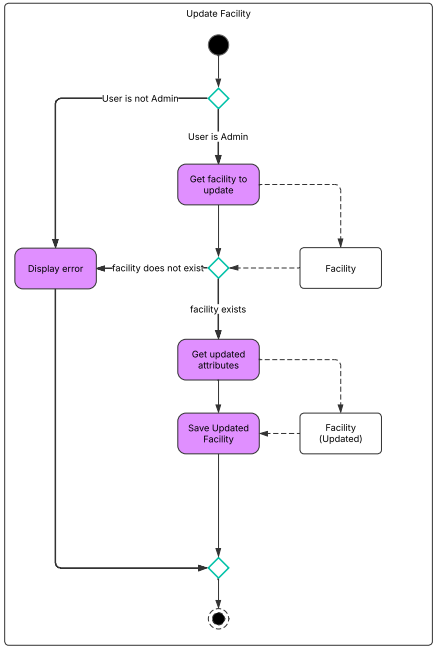


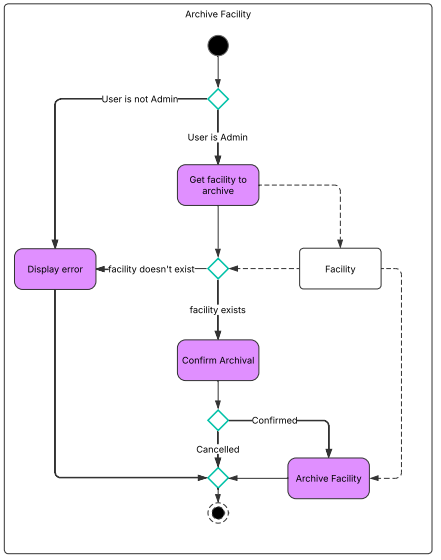


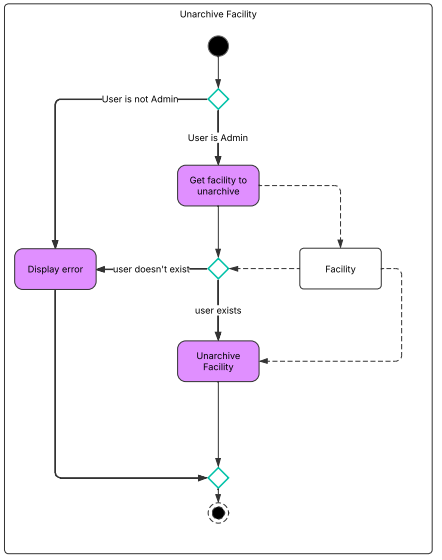
Facility Management









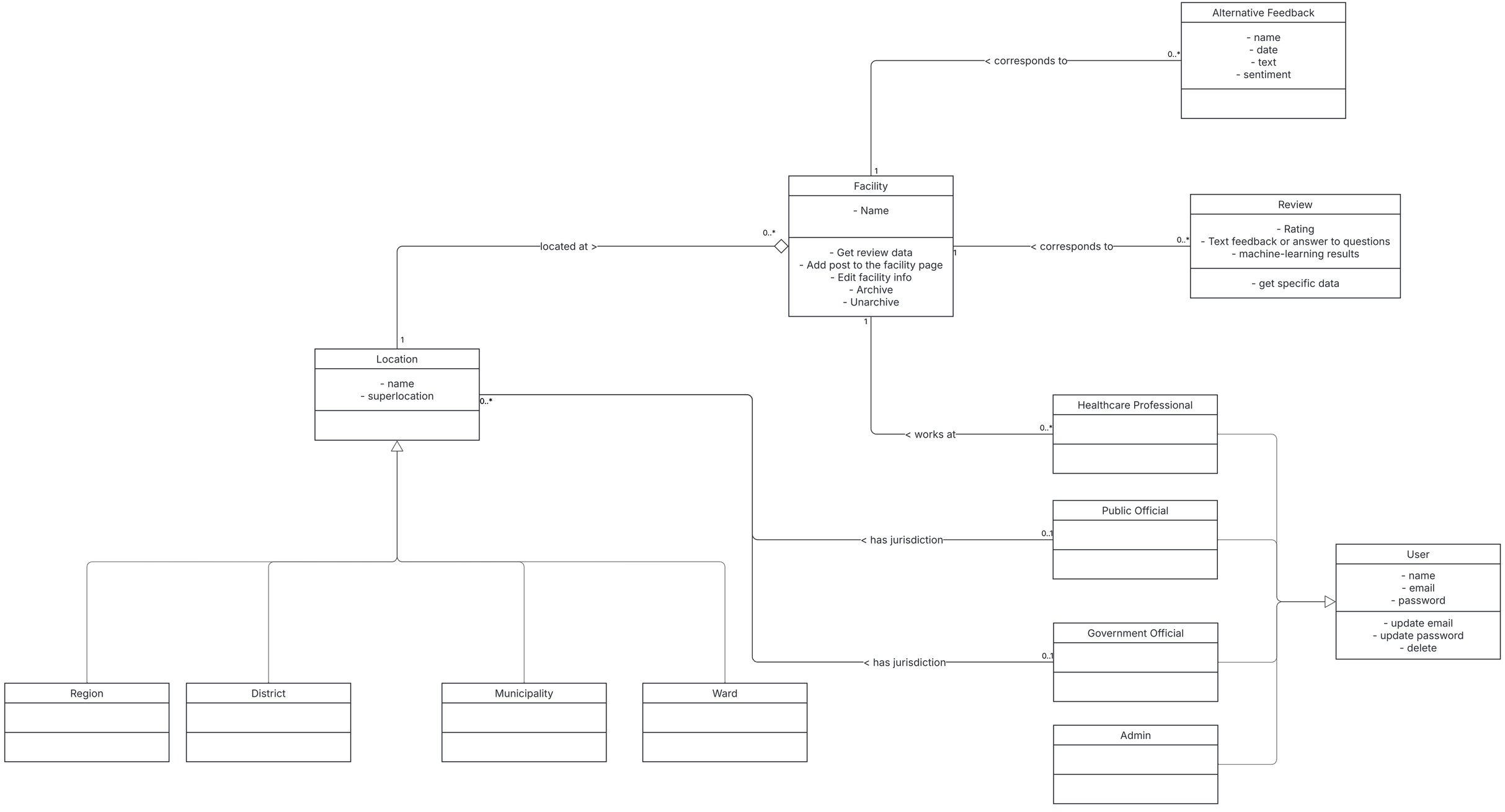


VI. Logical View

On the following page is a UML class diagram that models the logical view of the proposed system.

The entire system is logically centered around *facilities*, which have numerous *reviews* and *alternative feedback* instances. A facility is also located in a specific place, which is represented by a *location*. Locations take the form of *regions, districts, wards,* or *municipalities*, of which the smaller divisions of the country have "superlocations," or the location in which they are located.

The system also deals with numerous users. The most common user by far—the citizen—is not modeled, since no data is collected nor harbored by the system about them. However, other users have accounts that grant access to elevated privileges. These include *healthcare professionals*, who work at a specific *facility*, *government officials* and *public officials*, who have a specific jurisdiction (*location*), and *administrators (admins)*, who interact with the system in a much different way from the other users.


Alternative Feedback
- name
- date
- text
- sentiment
< corresponds to
0..*
1
Facility
- Name
- Get review data
- Add post to the facility page
- Edit facility info
- Archive
- Unarchive
0..*
located at >
1
1
< corresponds to
0..*
Review
- Rating
- Text feedback or answer to questions
- machine-learning results
- get specific data
Location
- name
- superlocation
0..*
1
< works at
0..*
Healthcare Professional
< has jurisdiction
0..1
Public Official
< has jurisdiction
0..1
Government Official
Admin
User
- name
- email
- password
- update email
- update password
- delete
Region
District
Municipality
Ward

VII. Data Model

On the following page is an entity relation diagram that gives the data model of the proposed system. The proposed schema is as follows *(underlined text indicates a primary key)*:

`User(id, email, password_hash, type, works_at_facility_id)`
`Facility(id, name, common_name, type, status, phone_number, address, email, website, location)`
`Reviews(review_id, facility id, ... [survey questions])`
`UserJurisdiction(user_id, region, district, ward, municipality)`
`Region(region_id, name)`
`District(district_id, name, region_id)`
`Ward(ward_id, name, district_id)`
`Municipality(municipality_id, name, ward_id)`

Similarly to the class diagram from section VI, this database design revolves around the *facility* table, which holds information about each facility in the system, including its name, status, contact information, and location. The location is a foreign key that corresponds to an entry in the *municipality* table, which is part of our modeling of the *location* object from the class diagram in section VI.

To model *locations*, we use the *region, district, ward,* and *municipality* tables. Each smaller division links back to the larger division it is a part of—for example `ward_id` in *municipality* is a foreign key that references the *ward* table.

Also, the *review* table and *alternate feedback* table correspond to the *facility* table, since reviews and other forms of feedback are facility-specific. *Users* are stored in another table, where the `type` column implements the different user types. To track which facilities a user can access more detailed information about, we need to track two things: employment and jurisdiction.

Employment is modeled using the *facility employee* table, which maps employees to the facilities where they work. Jurisdiction is modeled in the *user jurisdiction* table, where a user can have jurisdiction over a region, district, ward, or municipality.

Review		
PK	review_id	INTEGER
FK	facility_id	INTEGER
	area_satisfied_least	INTEGER
	other_feedback	TEXT
	other_feedback_sentiment	REAL

Depricated

Question		
PK	id	INTEGER
FK	surveyId	INTEGER
	text	TEXT
	textResponse	BOOLEAN

Survey		
PK	id	INTEGER
	name	TEXT

QuestionResponse		
PK	id	INTEGER
FK	questionId	INTEGER
FK	surveyResponseId	INTEGER
	responseInt	INTEGER
	responseText	TEXT

AlternativeFeedback		
PK	alternative_feedback_id	INTEGER
FK	facility_id	INTEGER
	alternative_feedback_date	TEXT
	alternative_feedback_text	TEXT
	alternative_feedback_sentiment	REAL

SurveyResponse		
PK	id	INTEGER
FK	surveyId	INTEGER
FK	facilityId	INTEGER

User		
PK	id	
	email	
	password_hash	
	type	
FK	works_at_facility_id	

Facility		
PK	id	
	name	
	commonName	
	type	
	status	
	phoneNumber	
	address	
	email	
	website	
FK	location	

UserJurisdiction	
FK	user_id
FK	region
FK	district
FK	ward
FK	municipality

Region		
PK	region_id	
	name	

District		
PK	district_id	
	name	
FK	region_id	

Ward		
PK	ward_id	
	name	
FK	district_id	

Municipality		
PK	municipality_id	
	name	
FK	ward_id	