

SuperNova Academy Inc.

Team Name: SuperAnteaters

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Trujillo

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Revision History

Revision article/section	reasoning	Date	Previous version
Functional Requirements	Discovered new requirements for the system. See Dated tag and Source.	11/16/2024	N/A
NonFunctional Requirements	Discovered new requirements and more questions to ask. (See Source/Dated section)	11/02/2024	N/A
Use Case Diagram	Created an encompassing diagram of actors and use cases with descriptions.	11/16/2024	N/A
Software Design	Added UML sequence diagrams accompanied by associated UML class diagrams for key features	11/25/2024	N/A

Assumptions

SuperNova's website Wordpress will be expanded rather than creating a companion application. SuperAnteaters will leverage the existing site and parity previous extension use when expanding said functionality.

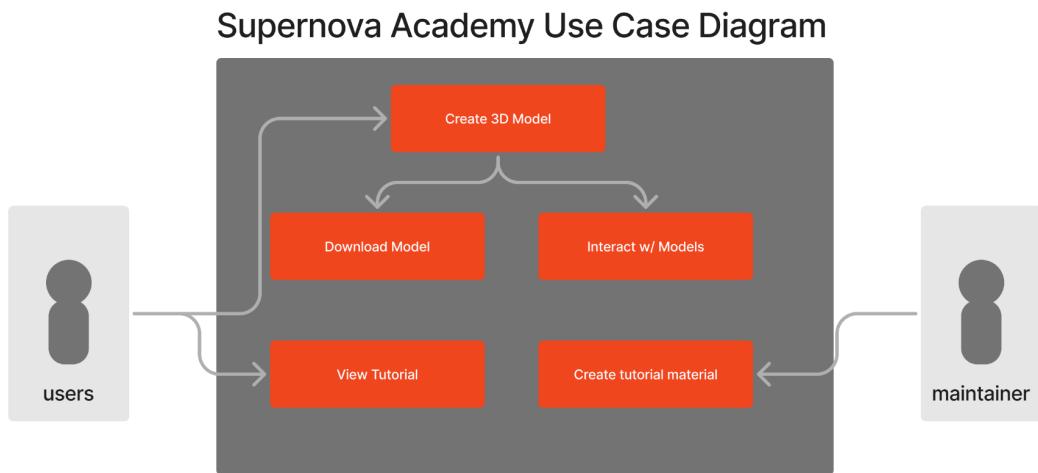
Moreover, SuperAnteaters have been notified that a CTO and developers has been hired as of 11/2/24. Thus, SuperAnteaters will assume that information during the sponsor meetings is being passed to other parties. If any concerns are brought by other party members inside SuperNova Academy, SuperAnteaters assumes the stakeholder will notify SuperAnteaters.

Introduction

SuperNova Academy Inc. offers software and programs that utilize Augmented Reality and Virtual Reality in order to view and analyze complex organs and regions of the human body. Our objective is to help visualize software in which users can upload 2D images of cancer-ridden body parts in order to create an interactable 3D model. The model should be compatible with both AR and VR. This software is primarily catered towards medical students and professionals to enhance medical education and collaboration. Our role in the project is to determine the feasibility of said conversions of 2D images into 3D models, as well as design a comprehensive prototype of the software to be displayed on the SuperNova Academy website.

Requirements

Use Case Diagram



Use case: Create 3D model

Id	#1
Actors	Users
Description	Users should be able to upload DICOM files and 3d models created from the files.
Primary Flow	<ol style="list-style-type: none">1. Users upload files in the format of DICOM using the UI.2. System converts the files to obj and rig the model with interactive hooks.3. User receives an interactive model.
Alternative Flow	<p>Wrong file</p> <ol style="list-style-type: none">1a. Users fail to upload the wrong file format.2a. System prevents further progression and alerts users of input error. <p>Failed process</p> <ol style="list-style-type: none">2b. Systems fail to convert models.3b. Users receive a UI update prompting users to retry modeling.
Requirements	#1, #5, #6, #8, //9, #14, #20, #35

Use case: Download Models

Id	#2
Actors	Users
Description	Users should be able to download models created by software and be allowed to upload the model to the software for future viewing.
Primary Flow	<ol style="list-style-type: none"> 1. Users will access created models through the UI and download the model.
Alternative Flow	<p>Failed Download</p> <ol style="list-style-type: none"> 1a. Users will be alerted of download error and will be prompted to reattempt download.
Requirements	#1, #9, #10

Use case: Interact with Models

Id	#3
Actors	Users
Description	Users should be able to interact with models using desktop browsers and/or mobile browsers.
Primary Flow	<ol style="list-style-type: none"> 1. Users will be able to select a model for viewing. 2. Users will be able to expand/rotate selected models.
Alternative Flow	<p>Failed Model Retrieval</p> <ol style="list-style-type: none"> 1a. Users will be alerted of error and will be prompted to reattempt select model again. <p>Side by Side comparison</p> <ol style="list-style-type: none"> 2a. Users are able to select two files by holding the mouse down on each file. 2a. Users will be able to select the “Split View” element after selecting two files. 3a. System will provide users with two cameras for each model allowing for Side by Side comparison. <p>Carousel comparison</p> <ol style="list-style-type: none"> 1b. Users are able to select multiple files by holding the mouse down on each file. 2b. Users will be able to select the “Carousel” icon after having multiple files selected. 3b. System will provide users with a carousel of each model with a modifiable ordering.
Requirements	#19, #22, #25

Use case: View Tutorial

Id	#4
Actors	Users
Description	Users should be able to view material that explains functionality provided by the software via the user interface.
Primary Flow	<ol style="list-style-type: none"> 1. Upon first opening the application, Users will be greeted with an interactive tutorial. 2. Users will be shown all features in a sandboxed environment.
Alternative Flow	<p>Experienced User</p> <ol style="list-style-type: none"> 1a. Users will be able to skip the tutorial via selecting the option in the tutorial <p>Revisiting Tutorial</p> <ol style="list-style-type: none"> 1b. Users will be able to reopen the tutorial to refresh themselves on the tutorial.
Requirements	#23

Use case: Create/Maintain Tutorial

Id	#5
Actors	Maintainer
Description	Maintainers should be able to update tutorials to match updates to functionality and/or presentation.
Primary Flow	<ol style="list-style-type: none"> 1. Maintainers will create new/update tutorials.
Alternative Flow	N/A
Requirements	#36

Personas

Nickname	The Student	The Patient	The Resident	The Web Dev
Name	Tessa Whitfield	Skyler Voss	Ethan Calder	Daisy Maines

Photo				
Age	24	32	46	28
Personality Traits	Tech-savvy, inquisitive, ambitious, smart	Worried, trusting, overwhelmed	Educated, traditional, empathetic, busy, detail-oriented	Tech-savvy, perfectionist, patient
Location	Urban	Coastal	Suburban	Coastal
Education	B.S. Biology	G.E.D/HS Diploma	Doctor of Medicine (MD)	M.S. Computer Science
Hobbies	Hiking, reading, puzzles	Traveling, videography	Cycling, cooking, writing	Drawing, 3D printing, photography
Scenarios	1	2	3	4

Scenarios

Scenario #1: Uploading 3D Models

User Story

As a student, I want to upload a 3D model so that I can visually learn how cancer impacts human organs using my phone's camera.

Priority

High

Acceptance Criteria

Test #1: User can upload a 3D model downloaded from a previous session. (FR #9 & FR #10)
Test #2: User can view the 3D model through AR on a mobile browser. (FR #20)

Estimate

10 pts

Scenario #2: 3D Models Comparison

User Story

As a patient, I would like to upload 3D models of my previous and current lesions from the hospital and compare them to understand the progress and status of my treatment.

Priority

High

Acceptance Criteria

Test #1: The user can view two 3D models simultaneously. (FR #22)
Test #2: The user can rotate and view the model in different directions. (FR #19)

Estimate

10 pts

Scenario #3: Uploading CT Scans

User Story

As a surgeon, I want to upload patient CT scans, so that I can understand and visualize the anatomy of cancer-affected regions via VR or AR.

Priority

High

Acceptance Criteria

Test #1: User can upload CT Scans in DICOM format and in turn view a 3D model. (FR #3, FR #5, & FR #6)
Test #2: User can view and dissect the 3D model using a VR headset. (FR #15, FR #19)

Estimate

10 pts

Scenario #4: Maintaining Documentation

User Story

As a web developer, I would like to curate a list of informational content so that I can decrease the amount of errors users experience when using the software

Priority

High

Acceptance Criteria

Will Require a follow up in next meeting.
Test #1: Allow for content modification on the case study page. (Assumption)

Estimate

10 pts

Priority Level	Meaning
High	Must have
Medium	Nice to have
Low	Great if we get to it

Functional Requirements

1. What is the primary objective of this software?
 - a. Take uploaded DICOM files from user/patients and convert them into 3d models that can be downloaded and viewed by the user. The user can select to view either using the website or have an AR experience with their mobile device.
 - b. **Updated: 11/02/24**
 - c. **Source: Stakeholder meeting #4**
2. Who are the main users or customers, and what value should the software provide to each of them?
 - a. Clinicians, doctors, physicians (eventually) (tool for patients as they come in) - ex, cancer patient comes in - doctors want to see the progression of the treatment - want to take snapshots throughout the process.
 - b. Medical students learn about pathology and study anatomy. Data sets would have to be brought by the users.
 - c. Nursing students, and biomedical engineers learning to define equipment for helping the medical community.
 - d. Educational, as well as for treatment.
 - e. **Dated: 10/19/24**
 - f. **Source: Stakeholder meeting #3**
3. Is this intended to be used as a diagnostic aid, a surgical planning tool, or both?
 - a. A visual aid that allows patients to learn more about their conditions and their progress through their treatment plan.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
4. Are there any existing solutions (internal and external), and what are their limitations?
 - a. Brainlabs. Allows patients to visualize their treatment journey.
 - i. Doing something at a much smaller scale.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
5. Could you describe the workflow of a typical user from start to finish?
 - a. Starting with the user data, uploading the data into software, and then converting that to a 3d Object. Use the object to convert into a 3D for AR/VR presentation.
 - b. All users have the same process.
 - c. Nice to have: Upload the files and provide the 3D models. Display the model through phone or desktop via headset.
 - d. **Dated: 10/19/24**
 - e. **Source: Stakeholder meeting #3**

6. Are there any specific inputs or outputs (e.g., reports, notifications) that the software must handle?
 - a. The program will handle CT scans in DICOM format and output 3D object files in .obj and .sli format.
 - b. **Updated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
7. What is the maximum dataset size (in terms of files or total data volume) we need to support?
 - a. Depends on the user. The average size of the current NIH datasets. For multiple patients.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
8. What happens when a user doesn't have enough files to create a model?
 - a. An error should be provided to the user.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
9. After the models are created, can a user save the model on their computer, or the website, or should the model be deleted?
 - a. The model should be available to save on your computer.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
 - d. **Extended in Requirement 10**
10. What should happen if a user uploads a 3D model created from a previous session?
 - a. Users would be able to play with the model once again.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
 - d. **Extends Requirements 9**
11. How many models should a person be able to create in a single session?
 - a. 10 models should be the limit.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
12. Should people be able to sign in before creating models?
 - a. Since storage will only be available by the session, users **will not** be required to login before creating models.
 - b. **Updated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
13. Are there existing systems or software that this needs to integrate with?
 - a. Integrate with 3D Slicer API service, Blender, database server, and WordPress website. Two servers. One serving the WordPress. Second serving the 3D slicer, blender, and database.

- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 14. What types of data does the system need to collect, store, or analyze?
 - a. Collecting DICOM files for the input and the obj. and fbx (another format for obj.). Not going to be storing the 3D models permanently or other files.
- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 15. What devices will the software run on (e.g., mobile, desktop, tablet)?
 - a. IOS, Android, and desktop. Only supporting htcVIVEPro2 headset.
- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 16. Are there any legal or industry-specific regulations the system must comply with?
 - a. HIPAA compliance. Copyright. FDA compliant.
- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 17. Should there be different permission levels for users? Should surgeons and students have different access to features or data? What features?
 - a. There is no feature difference between the users. Make sure that only authorized users access the data using role-based access.
- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 18. What external systems need to be integrated (e.g., hospital patient records, medical imaging systems)?
 - a. Nice to have: A plug-in for hospital systems to provide a 3D model before operations.
- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 19. What different features/actions can users do with the 3d models, is it just rotating them and dissecting them? (Or should we come up with further functionality)
 - a. The minimum is rotation and viewing the models.
- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 20. Should the dashboard be customizable, where users can add/remove sections?
 - a. The dashboard has functionality to view VR/AR, to view the progression (metrics), and choose to view through mobile.
- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 21. Should the system store a history of interactions with the 3D model? Should users be able to rewind to previous views, interactions, or changes?
 - a. No.

- b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 22. Should users have the ability to compare multiple models side-by-side?
 - a. Users would be able to compare two models side by side for viewing progression.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 23. Should users be served information on how to use the software before being prompted to upload files?
 - a. Yes. There should be a page before creating models that includes instructional material including a video explaining how to use the software.
 - b. **Date: 11/02/2024**
 - c. **Source: Stakeholder meeting #4**
- 24. Should users be allowed to rename models that they have created?
 - a. Users should be allowed to rename the previous model.
 - b. **Date: 11/09/2024**
 - c. **Source: Stakeholder meeting #5**
- 25. Should users be allowed to compare models side by side or linearly?
 - a. Users should be able to select either a side by side comparison or a linear comparison.
 - b. **Date: 11/09/2024**
 - c. **Source: Stakeholder meeting #5**

Non-Functional Requirements

- 26. Should a user be signed in to access any functionality? (Security?)
 - a. Multi-Factor Authentication?
 - i. Not initially.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 27. What is the availability of the service? Is it the same as the website?
 - a. Match the parent website.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 28. What is the oldest supported device for both desktops and phones? (Performance?)
 - a. Apple iPhone 8 and higher. Windows 10 and above. Support technology from beyond 2022.
 - b. **Dated: 10/19/24**
 - c. **Source: Stakeholder meeting #3**
- 29. What is the amount of users that can create models at the same time? (Scalability?)
 - a. Be able to support 100 users at a single time.
 - b. **Dated: 10/19/24**

c. Source: Stakeholder meeting #3

30. What should be the average build time for creating 3D models? (Speed)?

- a. Nice to have: Maximum one minute.

b. Dated: 10/19/24

c. Source: Stakeholder meeting #3

31. What should be the maximum storage afforded to a user? (Capacity?)

- a. 1 GB per model.

b. Dated: 10/19/24

c. Source: Stakeholder meeting #3

32. (If save data) Should we have methods such as cleansing or archiving for data that has been inactive for a long period of time?

Deprecated.

33. *Is there a need to provide users with the ability to archive data rollback? (Traceability)*

Deprecated.

34. What will be done with the data input by users once they are done using the system? Will it be saved in the system for future use, or will they just download it so that the data input can be deleted after? (Security?)

- a. The model should be deleted upon connection termination/interruption.

b. Dated: 10/19/24

c. Source: Stakeholder meeting #3

35. How should the system behave in the event of a failure, such as a server crash or data corruption? Should it automatically recover and resume operations?

- a. The system should cancel the operation and alert the user to submit new data.

b. Dated: 10/19/24

c. Source: Stakeholder meeting #3

36. How frequently might the instructional material informing the user on how to use the software change? How should changes be implemented?

- a. When the user interface changes in terms of UI layout or functionality, new instructional material should be created for users.

b. Dated: 11/09/24

c. Source: Stakeholder meeting #5

37. Should a single tutorial with all functionality be served to users or should tutorials be split based on feature need?

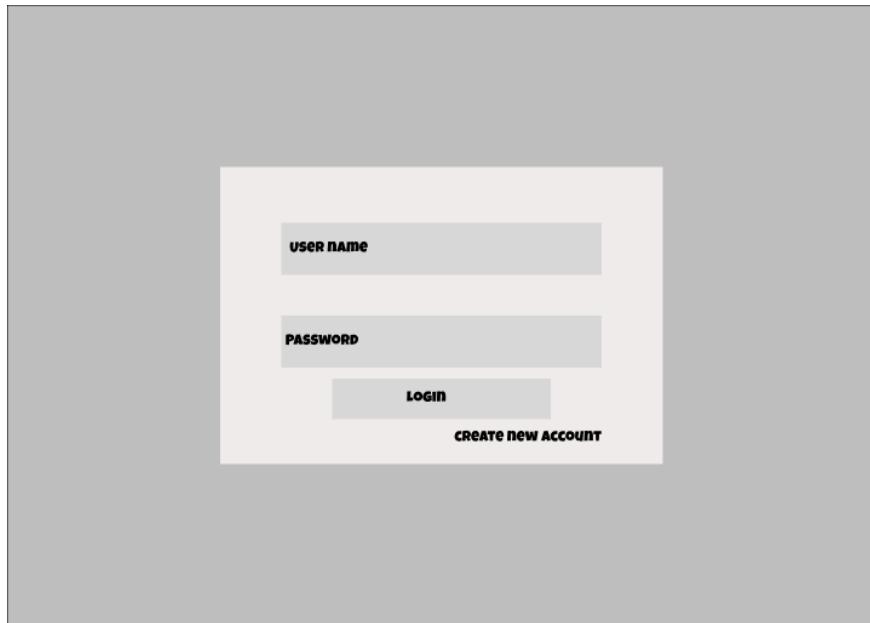
Meeting	Date
Stakeholder meeting #1	10/02/2024
Stakeholder meeting #2	10/12/2024
Stakeholder meeting #3	10/19/2024

Stakeholder meeting #4	11/02/2024
Stakeholder meeting #5	11/09/2024
Stakeholder meeting #6	11/16/2024

UI Design

Low Fidelity Screens

Login Screen



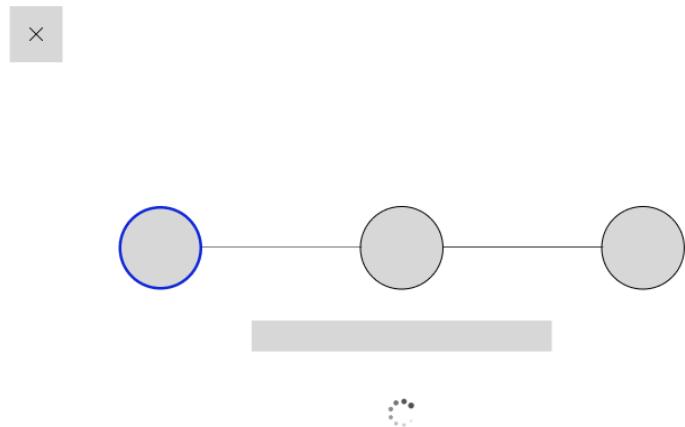
Feedback

The sponsor decided to part ways with the requirement of having users to login before creating a model (See updated requirement #12). Thus, this screen will be deprecated.

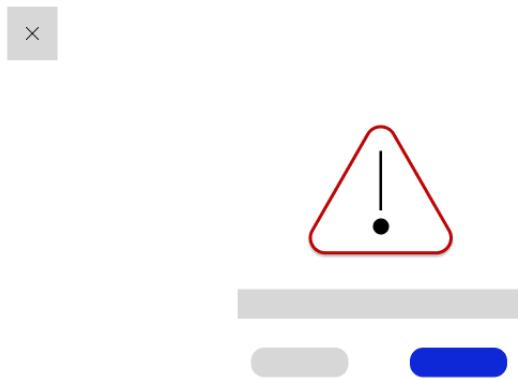
Upload File Screen



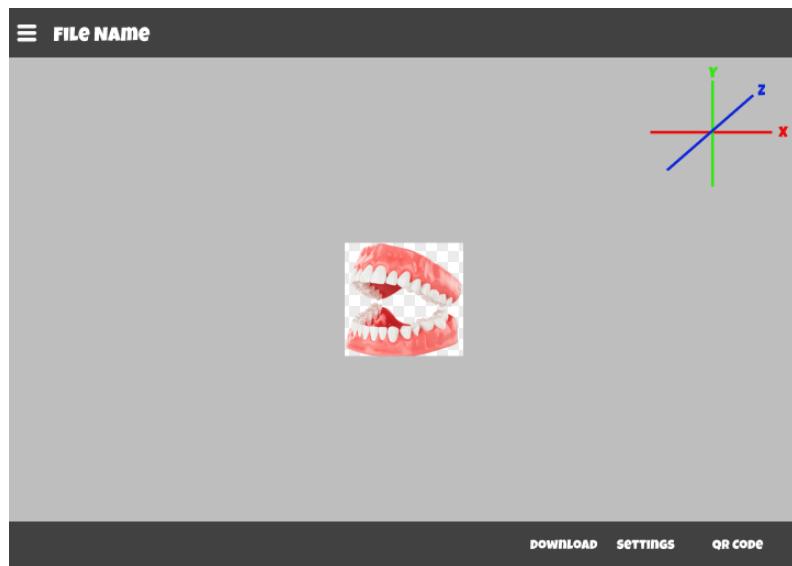
Loading/Processing File Screen



Error Screen



Website Model Screen



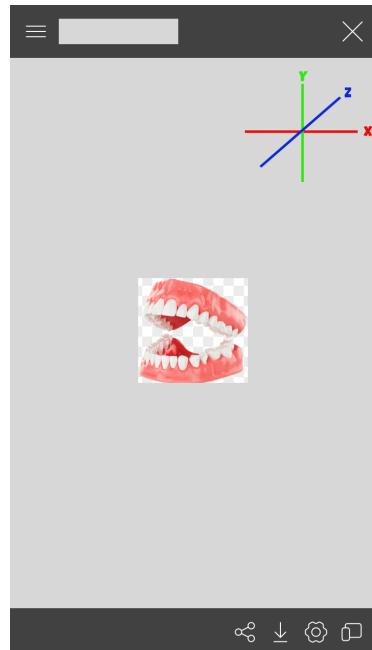
Sidebar Menu



QR Code



Mobile Model Screen



Overall Feedback

- The sponsor has decided not to pursue the login screen
- The sponsor believes the login screen should be replaced
- The sponsor has decided not to pursue VR for website implementation
- Sponsor likes the overall design and awaits a high fi prototype

Storyboards

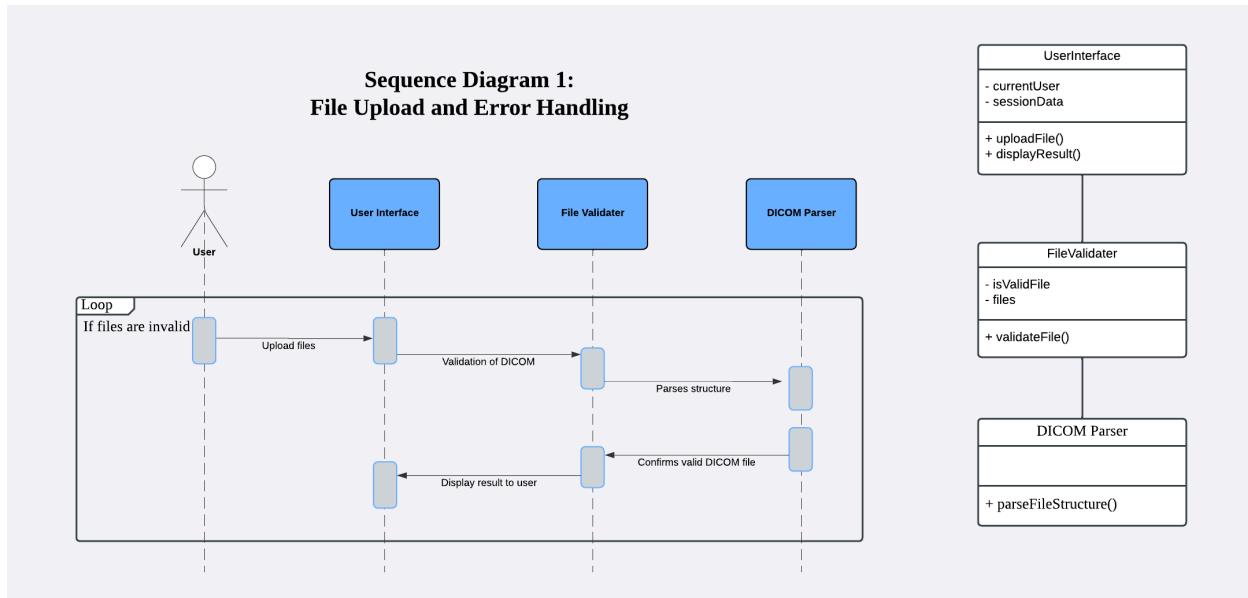
(See Personas The Web Dev and Scenario #4)



Software Design

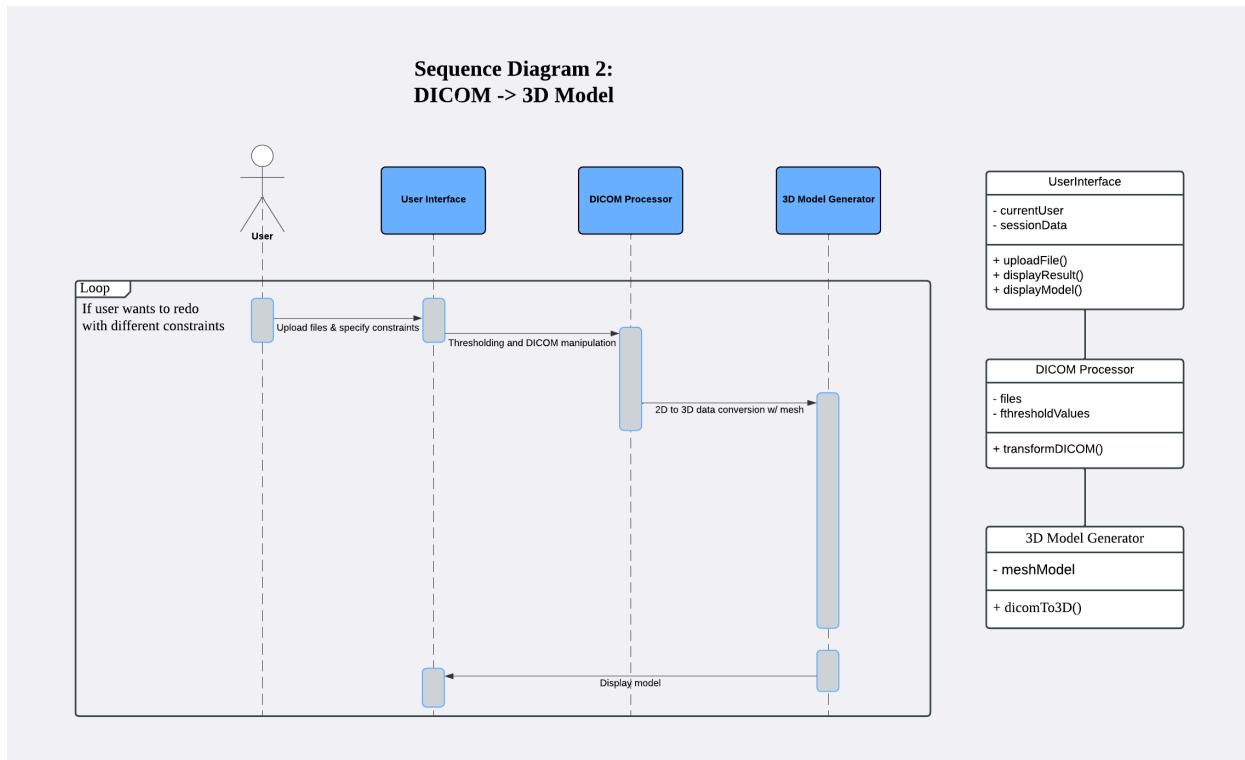
- **Sequence Diagram 1: File Upload and Error Handling**

Use Case: This diagram captures the basic flow where users upload DICOM files, and the system validates their format and structure. It focuses on error detection and user feedback, with loops for re-uploading invalid files.



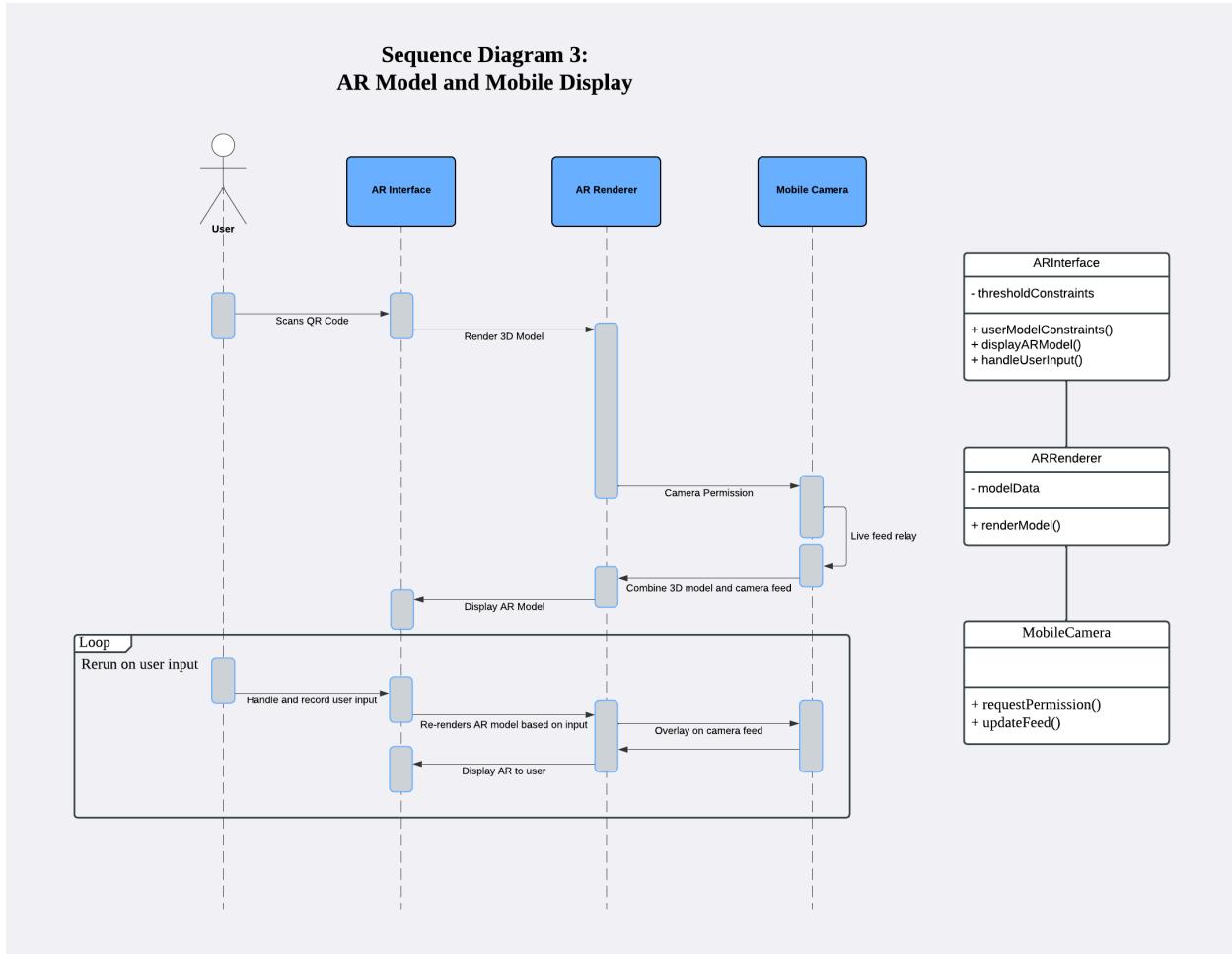
- **Sequence Diagram 2: DICOM -> 3DModel**

Use Case: This diagram captures the transformation of validated DICOM files into 3D models. It includes user input for constraints and rendering interactions between the DICOM processor and the 3D model generator. It also includes a loop to ensure that the model meets the user's specifications.



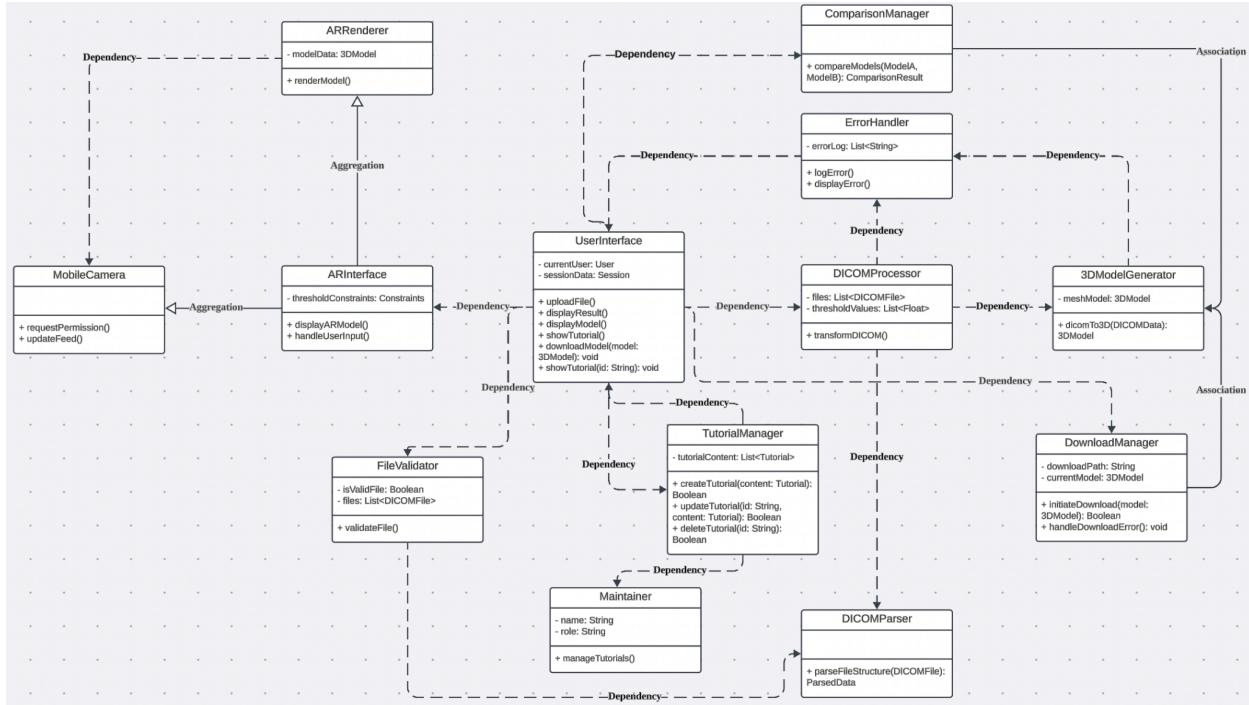
- **Sequence Diagram 3: AR Model and Mobile Display**

Use Case: This diagram captures the incorporation of augmented reality and a mobile camera. It demonstrates the interactions between the AR interface, AR renderer, and mobile camera which all work together to overlay the 3D models onto the live camera feed.



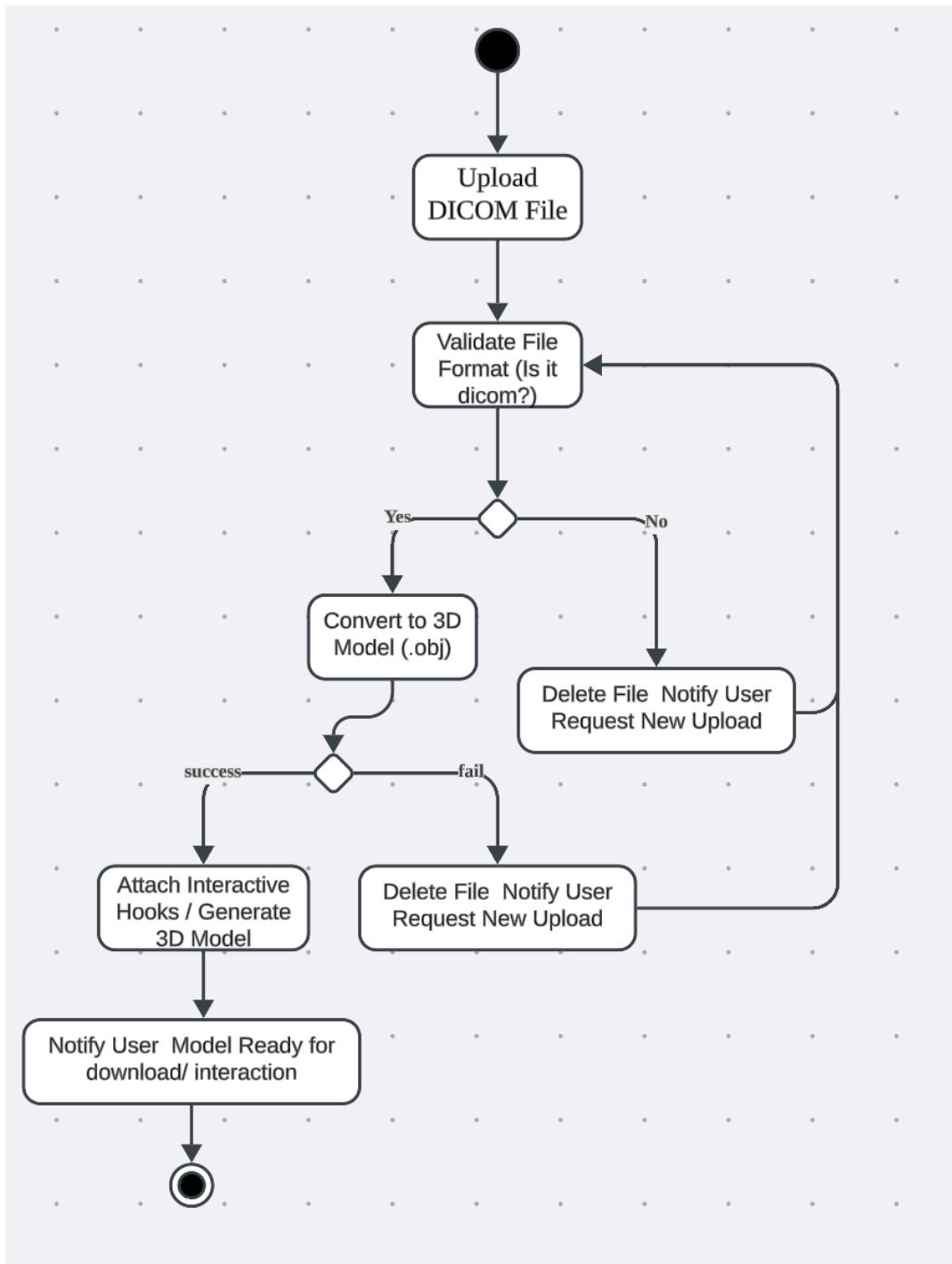
● Summary UML Class Diagram

This UML diagram illustrates all modules and their interactions within the system. It includes key classes such as MobileCamera, ARRenderer, UserInterface, and DICOMProcessor, along with detailed attributes and methods for each class. The relationships between the classes, such as dependencies, aggregations, and associations, are clearly defined to represent the data flow and functional calls.



● Additional Diagram: Activity diagram

This UML diagram represents the activity flow of uploading DICOM files and generating 3D models. It includes key steps such as file format validation, model conversion, and user notifications. The process branches into success and failure paths, with clear handling of errors like incorrect file formats by prompting the user to re-upload. This diagram captures the essential logic and exception-handling mechanisms of the system workflow.



- **UI Design:** Home Screen

The screenshot shows the homepage of supernova academy inc. The top navigation bar includes links for Home, News, Services, Resources, CaseStudies (which is underlined), ARModels, AboutUs, ContactUs, Courses, and MyAccount. Below the navigation is a section titled "Case Studies" with a red underline. On the left, there's a "Get to Know the Software" section featuring a grid of medical scans and a purple play button. To the right, there's a "Case Studies" section with a heading "Convert CT Scans to 3D Models" and a subtext "Visualize and interact with 3D models of cancerous regions." A "Generate" button is located below this section.

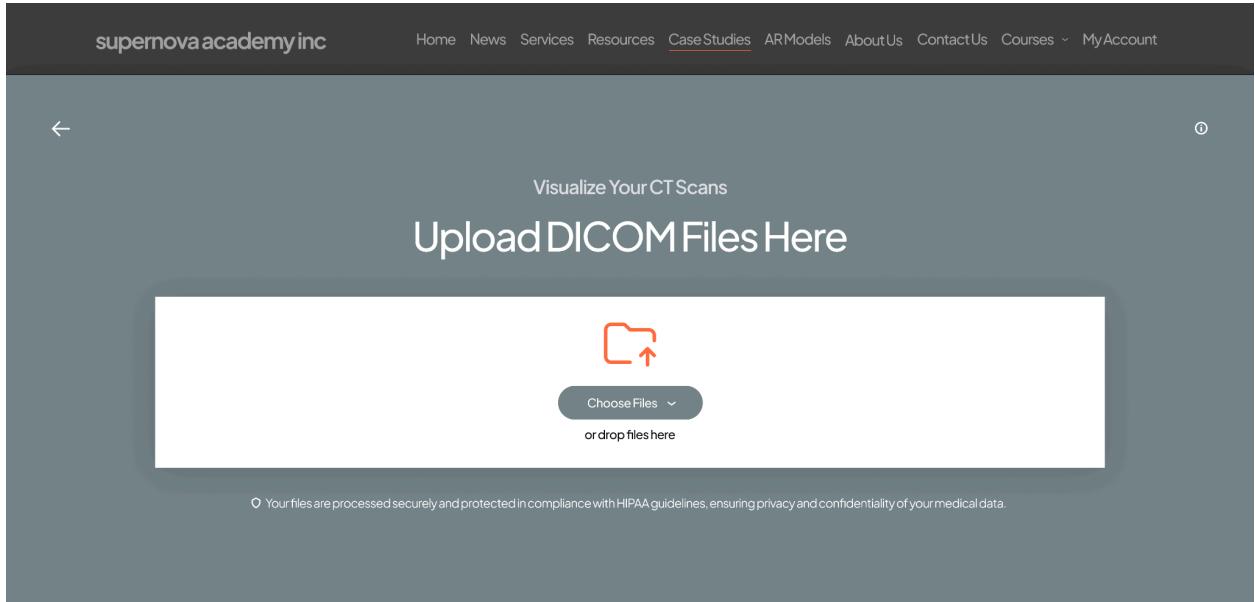
Key Components

- The “Get to Know the Software” Carousel consists of a **1) Demo video 2) Step-by-Step Guide 3) 3D Model Information**
- The “Generate” Button leads users to a screen where they can upload CT Scans

Interactions

- Functional
 - Carousel - pressing on a different square will spin the order so that it is now in front
 - Carousel - pressing on the dots to the right side of it will also spin the order
 - Generate Button - leads to Upload screen
- Aesthetic
 - Carousel - Each square (Videos + Image background with text) has a purple gradient overlay [matching with several other aspects of the Sponsor’s current website]
 - Generate Button - Hovering turns it purple

- **UI Design:** Uploading Screen



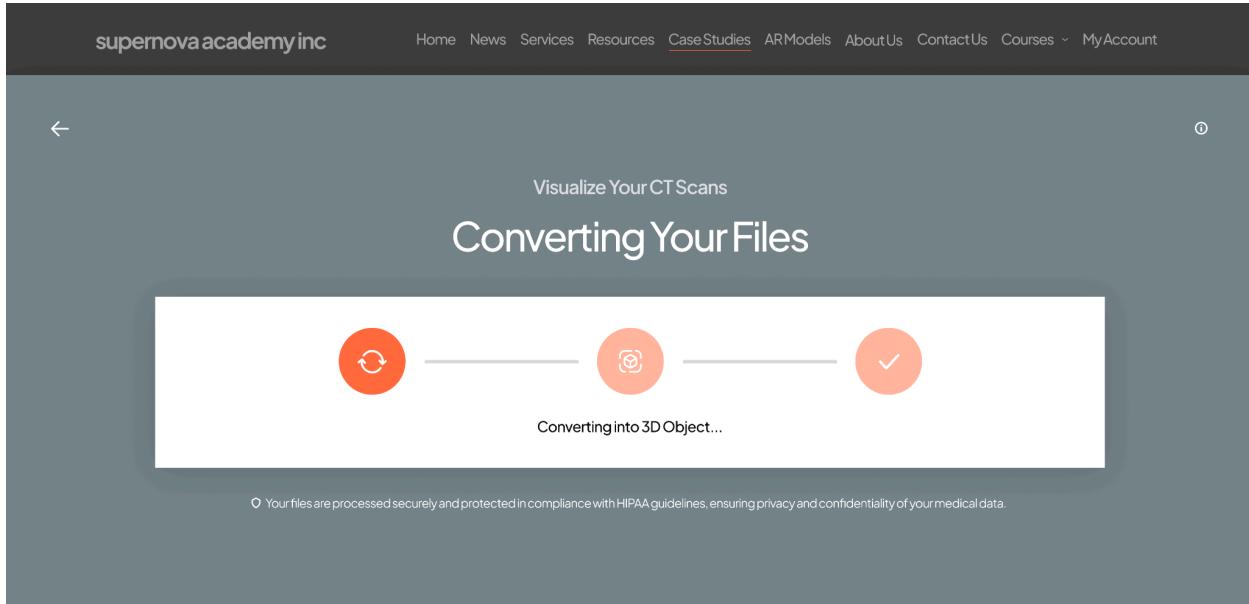
Key Components

- The “Choose Files” Button allows users to upload files
- The white file box allows for the dragging and dropping of files

Interactions

- Functional
 - Choose Files Button - Pops up the user’s file explorer to upload desired files
 - File Box - Allows for the dragging and dropping of files
 - i symbol [top right] - Opens information regarding the software’s steps + demo video
 - AFTER uploading - The processing screen will appear
- Aesthetic
 - Choose Files Button - Hovering turns it orange
 - Grey Background - Expanded from the last screen for an immersive feel

- **UI Design:** Upload Processing Screen



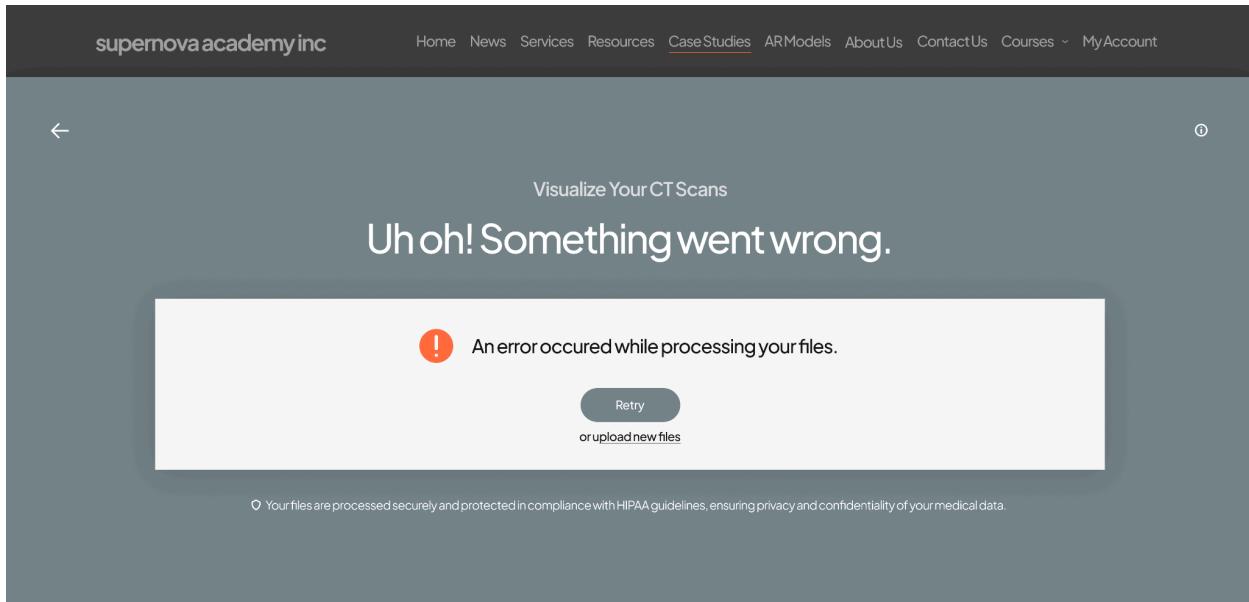
Key Components

- There is a loading diagram that updates depending on which stage of processing is occurring

Interactions

- Functional
 - Possible Loading Icon Interactions - **1)** the grey bars between icons fade in and out depending on the step of the process (either complete in-and-out fade OR horizontal gradient fade) **2)** the icons have motion interactions - **ICON 1:** Spin and stop... Spin and stop **ICON 2:** Dashed square border zooms in and out **ICON 3:** Shake or Pop
 - **i** symbol [top right] - Opens information regarding the software's steps + demo video
- Aesthetic
 - n/a

- **UI Design:** Upload Processing Error Screen



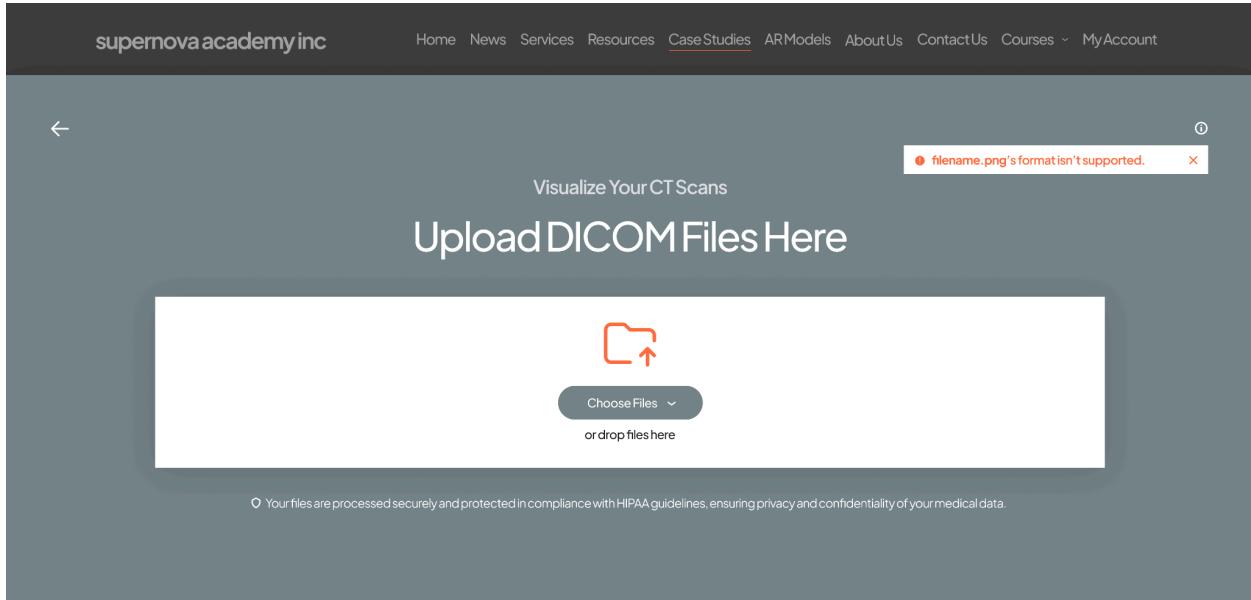
Key Components

- When a file doesn't process correctly an error message appears
- The "Retry" Button leads users to retry the same files again
- The "Upload New Files" Underlined Text leads users back to the Uploading screen

Interactions

- Functional
 - Retry Button - Processes the original files again, leading the user to the Processing screen
 - Upload New Files Underlined Text - Leads to Upload screen
- Aesthetic
 - Retry Button - Hovering it turns it orange

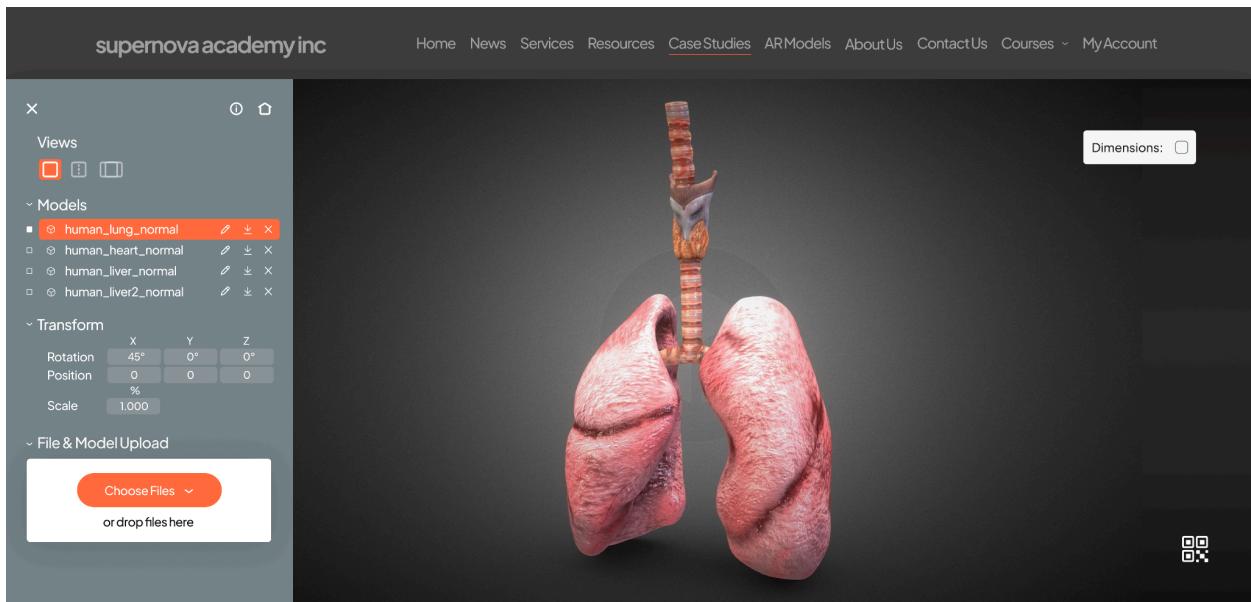
- **UI Design:** Upload Incorrect File Type Error Screen



Key Components

- An error message pops up in the top right corner when the format isn't DICOM

- **UI Design:** Model Screen - Default



Key Components

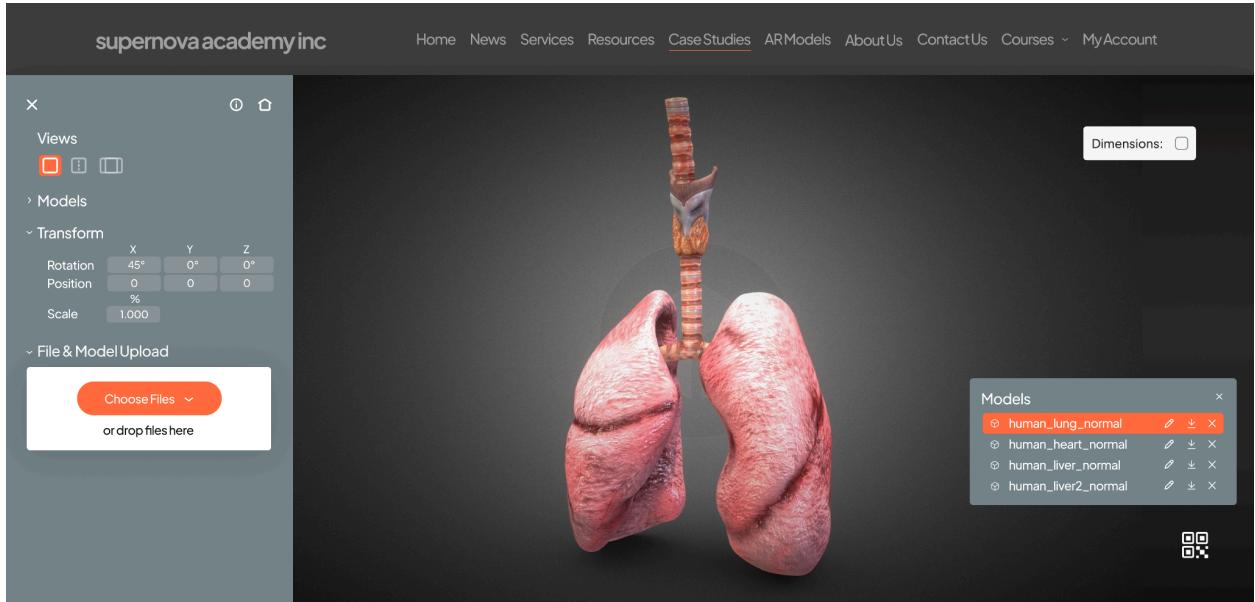
- Default opens with the sidebar open so that users know what it encompasses + where it is located
- Section to control the view of models

- Section to select, edit, download, and manage 3d models
- Section to edit the orientation and scale of 3d models
- Section to upload additional files

Interactions

- Functional
 - Views Section - **1 model** selected - only Single-view available **2 models** selected - defaulted to Side-by-Side view, Carousel view is available, Single-view is disabled **3+ models** - only Carousel view available
 - The order affects the order of the *Carousel view*
 - Models Section - Small White Box - Selects models to view
 - Models Section - Orange Highlight - Clicking on a model's name selects it... If it is selected via White Box, that is the model that the Transform settings will directly impact
 - Models Section - Rename icon, Download icon (as OBJ), Delete icon
 - Transform Section - Edit the currently selected model's rotation, position, and scale
 - Arrows Next to Section Headings - Open and close/hide each menu
 - ALL SECTIONS - Sections can be dragged out of the sidebar and placed anywhere on the screen to allow for flexibility and more seamless use of the software - don't have to open the sidebar every time [Covered further in next screen]
 - QR Code [bottom right] - Opens a pop-up window with a QR Code for the Mobile AR View of all models [Covered further in later screen]
 - Home Icon - Opens a pop-up window asking the user if they want to exit to the home page and lose their models or not [Covered further in later screen]
 - Dimensions - Will display dimensions around the model, similar to the dimensions feature already implemented on the current website's models
- Aesthetic
 - Views Section - Hovering each view icon pops up a small label with the name of the view
 - File & Model Upload Section - Choose Files Button - Hovering turns it purple

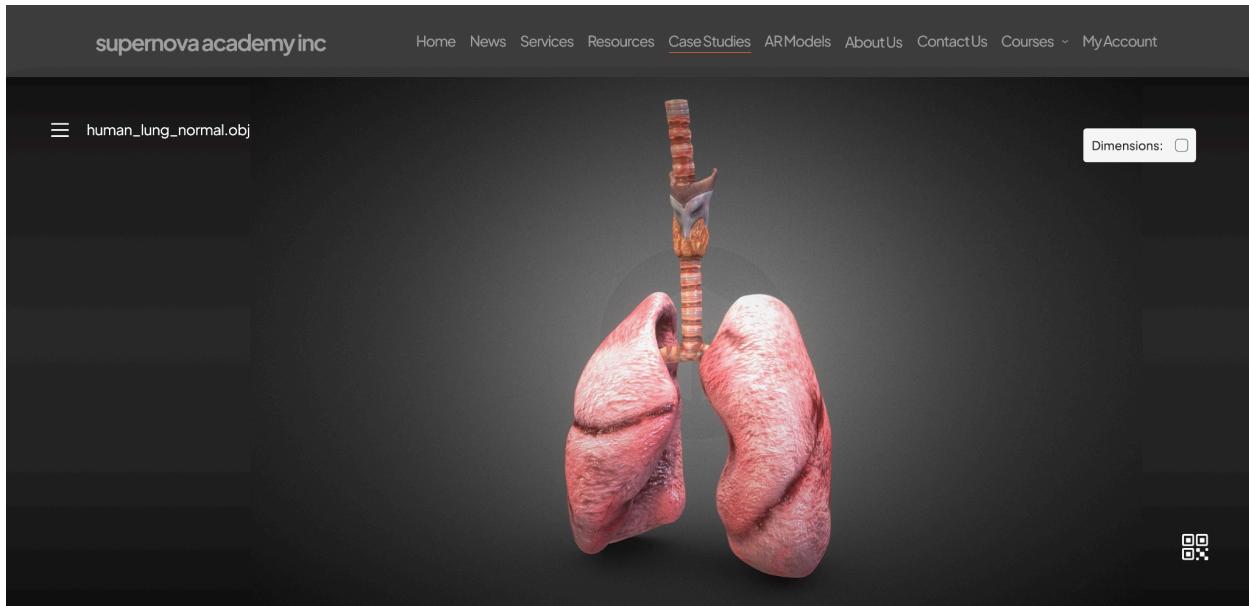
- **UI Design: Model Screen - Variant**



Key Components

- Sections can be dragged out of the sidebar and placed anywhere on the screen to allow for flexibility and more seamless use of the software - don't have to open the sidebar every time
 - Clicking the 'x' on the small window will reopen the tab on the sidebar
 - Dragging a window out will close the tab on the sidebar
 - It can be opened in the sidebar and also exist outside of the sidebar, but further instances of that same section cannot be dragged out [only one external instance per section at a time]

- **UI Design:** Model Screen



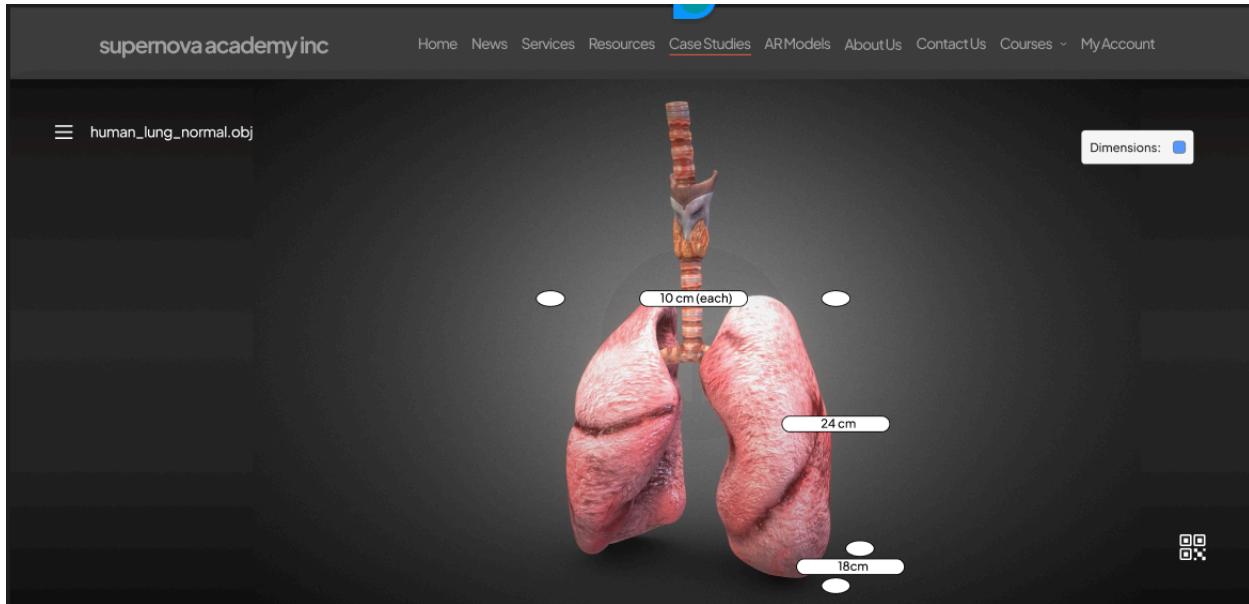
Key Components

- The sidebar is closed and can be reopened via the hamburger menu icon
- The name of the currently displayed model is next to the icon

Interactions

- Functional
 - Hamburger Menu Icon - Opens sidebar
- Aesthetic
 - n/a

- **UI Design:** Model Dimensions



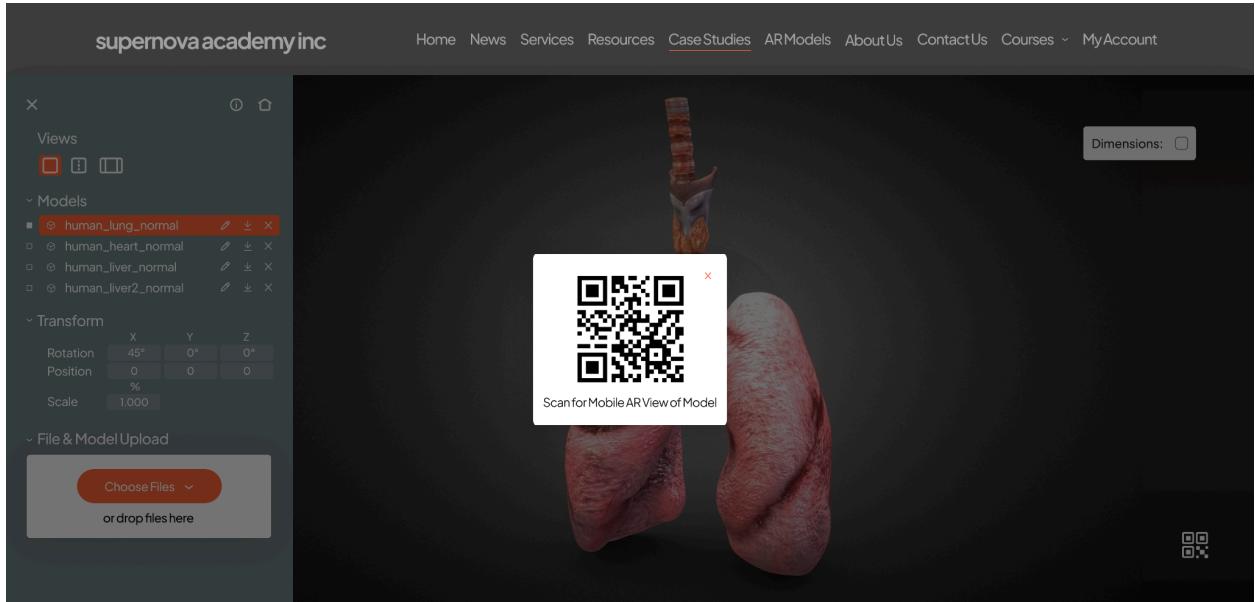
Key components:

- Dimensions (l/w/h) of the model are visible when dimensions is toggled
- The ellipses each measurement is between determine which dimension is being referred to
- Burger drop down menu version implemented so that the dimensions will stay on the model as long as the model is still on screen

Interactions:

- Clicking the dimension toggle will turn the visible dimensions invisible.

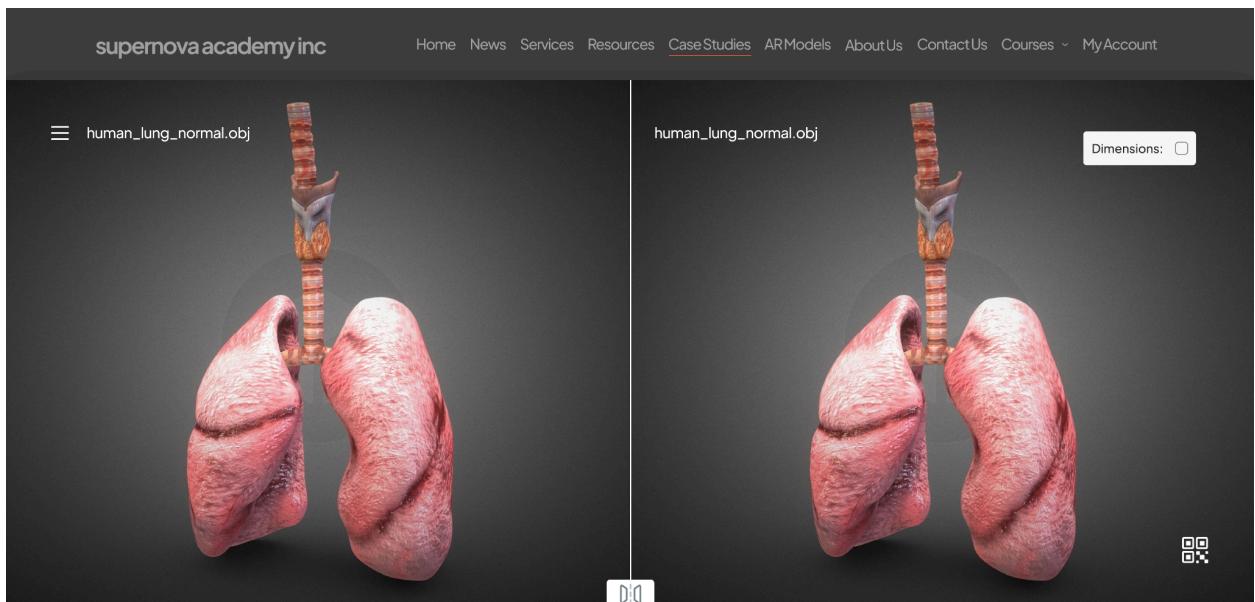
- **UI Design: QR Code Screen**



Key Components

- QR Code is scannable via mobile device

- **UI Design: Side-by-Side Model Screen**



Key Components

- The side-by-side view places two models next to each other to be seen concurrently

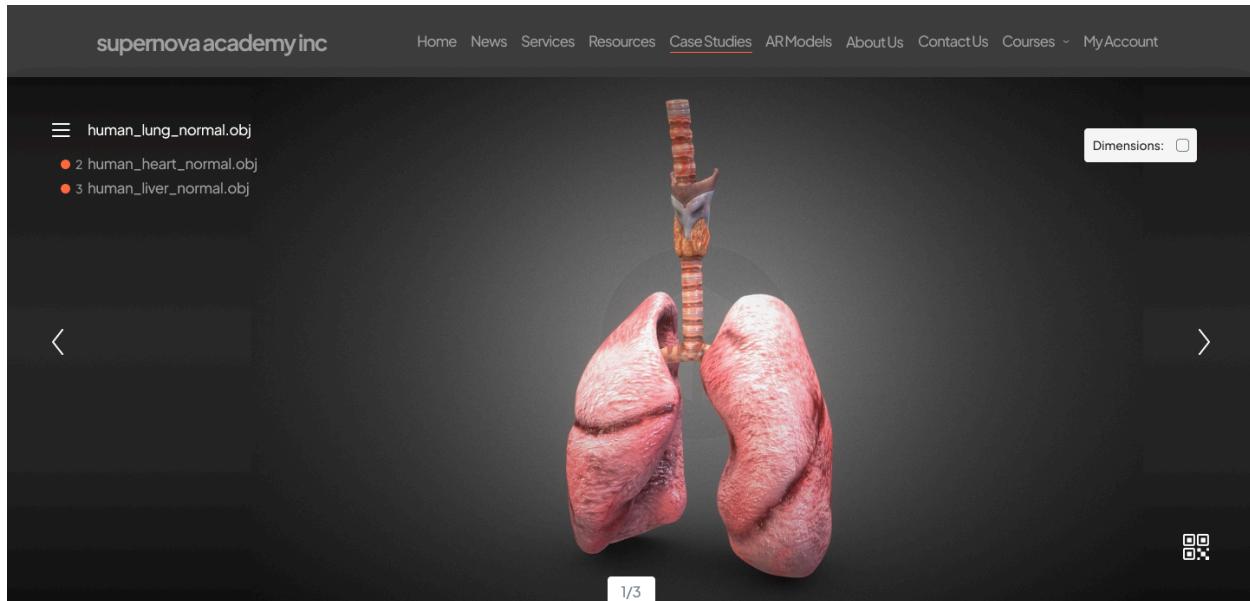
- There is a flip icon that allows the models to switch sides

Interactions

- Functional

- Flip Icon [Bottom Middle] - Pressing this switches the models' position (the one on the left is now on the right, and the one previously on the right is now on the left)

- UI Design: Carousel Model Screen



Key Components

- The carousel view puts multiple models in display, and they can be viewed either by **1) the arrows on the sides or 2) pressing the name on the queue**

Interactions

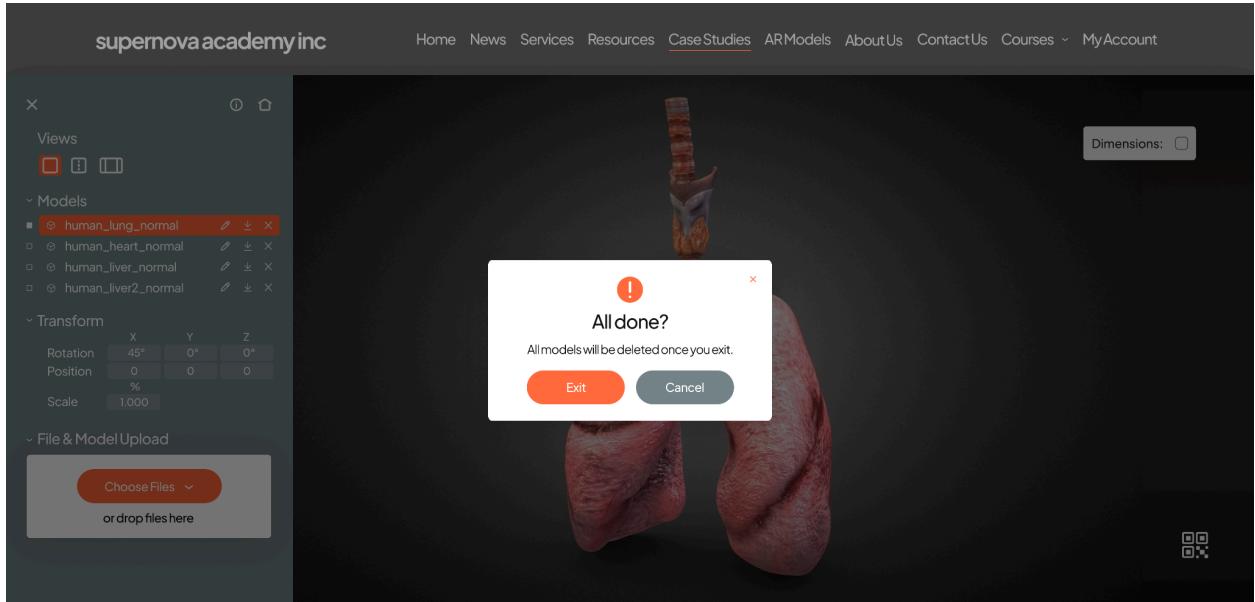
- Functional

- Queue [Underneath hamburger menu icon] - shows positions of files and is clickable (clicking on a model's name will display that name)
- Arrows - Scroll through the models, in which the order of display is shown in the queue

- Aesthetic

- Number at the bottom of the screen - displays which model number is currently displayed

- **UI Design:** Exiting Model Screen



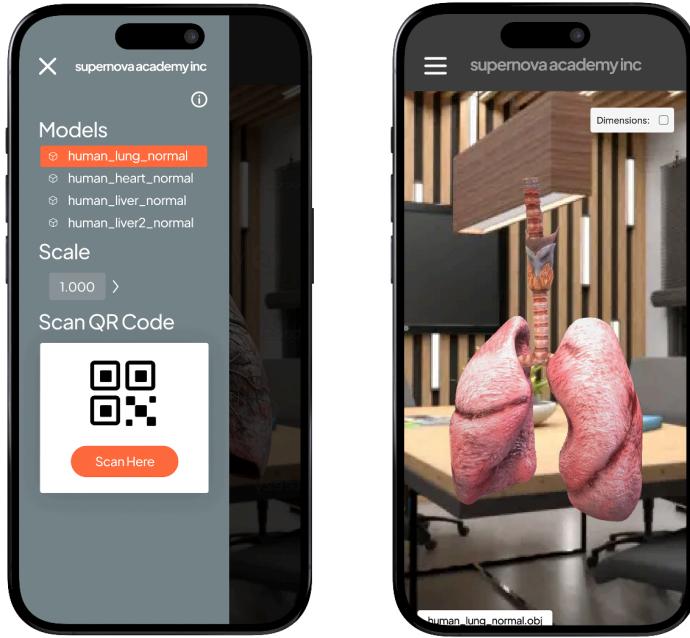
Key Components

- Confirms if users want to exit to the homepage
 - Warns users that doing so will lose all of their progress/models

Interactions

- Functional
 - Exit Button - Brings user back to the landing page of Case Studies
 - Cancel Button - Closes pop-up and resumes model session as before
- Aesthetic
 - n/a

- **UI Design:** Mobile Model Screen



Key Components

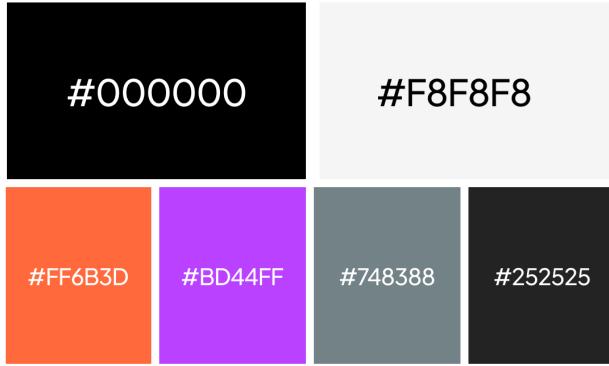
- A standardized version of the sidebar - lacks the ability to edit names, download files, or delete models
- Only allows single-view

Interactions

- Functional
 - Model Names - Selecting a name displays that model on the AR display
 - Scale - Adjusts how zoomed in the model is (in case they can't use finger-pinch to zoom)
 - Scan QR Code - Scan Here Button - Opens the user's camera to replace the session with new models

- **Colors and Fonts**

Color Guide



Type-Scale

Header 1

46px

Header 2

22px

Header 3

22px

Header 4

17px

Body 1

17px

Button

14px

Detail

12px

● Figma Prototype

<https://youtu.be/uHKd7KJo2Xg>

Software Testing

Unit Test Specification: File Upload Validation

Purpose: Ensure the system accurately validates file formats during the upload process.

Test Steps:

1. Simulate file uploads using mock DICOM files and invalid file formats (e.g. jpg/png).
2. For valid DICOM files:
 - Mock the file structure to test boundary conditions (e.g., minimal file size, corrupted headers).
3. Verify error handling for invalid files.
4. Test file size constraints to ensure large files are rejected appropriately.

Expected Results:

- The system accepts valid DICOM files and provides feedback indicating success.
- Invalid file formats trigger clear and actionable error messages.
- Large files exceeding the allowed limit are rejected with appropriate notifications.

Coverage:

- Code Coverage: Validation logic.
- Use Case Coverage: Upload file requirements.
- GUI Coverage: File selection interface feedback.

Report Example:

- Test Input: Valid file format, 50MB size.
- Expected Output: File accepted and processed.
- Result: PASS.

Unit Test Specification: QR Code Scanning for AR Model Display

Purpose: Validate the QR code scanning functionality for loading 3D models in AR view on mobile devices.

Test Steps:

1. Generate a QR code for an existing 3D model.
2. Use a simulated mobile device to scan the QR code.
3. Verify the following:
 - The QR code redirects to the correct model link.
 - The AR interface loads the 3D model successfully.
4. Test invalid QR codes to ensure proper error handling.
5. Simulate interruptions during the scanning process (e.g., poor network connection).

Expected Results:

- Valid QR codes redirect to the correct 3D model and load it in AR view.
- Invalid QR codes trigger a clear error message without crashing the application.
- Interrupted scans allow users to retry without restarting the app.

Coverage:

- **Code Coverage:** QR code generation, scanning, and model loading logic.
- **Use Case Coverage:** AR view access via QR code.
- **GUI Coverage:** Feedback for successful and unsuccessful scans.

Report Example:

- **Test Input:** Valid QR code generated for a 3D model.
- **Expected Output:** 3D model loads in AR view successfully.
- **Result:** PASS.
- **Test Input:** Invalid QR code scanned.
- **Expected Output:** Error message displayed.
- **Result:** PASS.

System Test Specification: Model Generation Workflow

Purpose: Validate the full workflow from file upload to 3D model generation.

Test Steps:

1. Simulate user interaction for uploading a DICOM file.
2. Mock the DICOM-to-3D model conversion process using a controlled environment.
3. Test user feedback during processing (e.g., progress bar updates).
4. Simulate system failure scenarios (e.g., conversion timeout, server crash) and test recovery mechanisms.

Expected Results:

- Successful conversion results in a 3D model with interactive features.
- Failures provide users with actionable retry options.
- Processing time adheres to specified limits (e.g., <1 minute).

Coverage:

- Code Coverage: Model generation algorithm.
- Use Case Coverage: 3D model generation requirements.
- GUI Coverage: Feedback on progress and error handling.

Report Example:

- Test Input: Valid DICOM file, no user interruptions.
- Expected Output: 3D model generated and accessible.
- Result: PASS.
- Test Input: Server timeout simulated.
- Expected Output: The retry option is displayed to the user.
- Result: PASS.

System Test Specification: Model Comparison Workflow

Purpose: Verify the functionality of side-by-side and carousel model comparisons.

Test Steps:

1. Upload or generate three 3D models.
2. **Side-by-Side View:**
 - Select two models and display them side by side.
 - Rotate, zoom, and manipulate each model independently.
 - Use the "Flip" button to swap their positions.
3. **Carousel View:**
 - Display all three models in carousel view.
 - Navigate between models using arrows and queue selection.
4. Simulate selecting more than two models for side-by-side comparison and observe the response.
5. Test error handling for a failed model load.

Expected Results:

- Side-by-side view shows two models correctly, with independent manipulation and proper "Flip" functionality.
- Carousel view allows smooth navigation and accurate display of selected models.
- Selecting more than two models for side-by-side comparison triggers a restriction message.
- Failed model loads prompt retry or skip options.

Coverage:

- **Code Coverage:** Comparison logic and error handling.
- **Use Case Coverage:** Comparison use cases (side-by-side, carousel).
- **GUI Coverage:** Feedback, navigation controls, and error messages.

Report Example:

- **Test Input:** Two models for side-by-side view.
- **Expected Output:** Models manipulated independently and swapped correctly.
- **Result:** PASS.
- **Test Input:** Three models in carousel view.
- **Expected Output:** Smooth navigation and accurate model display.
- **Result:** PASS.

Performance Test Specification: Scalability Under Load

Purpose: Assess system behavior under concurrent usage.

Test Steps:

1. Simulate 100 concurrent users uploading files and generating models.
2. Monitor system resource utilization (CPU, memory, and network bandwidth).
3. Test system responsiveness and error handling under peak load.

Expected Results:

- The system supports up to 100 users without noticeable degradation.
- Errors during peak usage are gracefully handled and reported.

Coverage:

- Non-functional Properties: Scalability, performance, and robustness.

Report Example:

- Test Scenario: 100 concurrent users, 1GB DICOM files.
- Expected Output: All users complete the process successfully within 1 minute.
- Result: PASS.

Figma Link

<https://www.figma.com/proto/1ZU5AWeX4EyM6BkWliEyl3/wireframes?node-id=92-26&starting-point-node-id=92%3A26&t=nqM5NwPex6kfGyho-1>