naesView: A Secure and Intuitive Platform for Collaborative Medical Image Evaluation

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Abstract

Advances in artificial intelligence and imaging technologies are transforming medical research, creating new opportunities for collaboration between technical developers and clinical experts. However, these collaborations are often hindered by complex workflows, data-sharing restrictions and diverse software environments. naesView is a lightweight, browser-based platform designed to facilitate collaborative evaluation of medical images while maintaining strict data security. The system enables configurable, project-based review workflows without software installation or external data transfer. By keeping all image data local and only transmitting non-sensitive metadata, naesView minimizes regulatory overhead while supporting structured, reproducible image evaluations. This paper presents the system's architecture, design principles, and representative use cases demonstrating its practical utility in medical imaging research.

Keywords: List of keywords, comma separated.

1. Introduction

Over the years, medical imaging has undergone a notable transformation. Advances in technology and the emergence of diverse imaging modalities have not only enhanced the quality and resolution of images but have also led to an unprecedented accumulation of complex datasets. As the volume of data grows, so does the potential for new diagnostic insights and research breakthroughs.

Today, medical imaging research increasingly depends on collaboration among a diverse group of experts — from clinicians and radiologists to data scientists, physicists, and engineers. While this interdisciplinary approach offers rich opportunities, it also introduces practical challenges, such as efficiently and securely evaluating large numbers of medical images across different teams and settings. These challenges can lead to delayed feedback, slow project results, or even abandoned collaborations.

To address these challenges, we have developed naesView, a lightweight, browser-based platform for collaborative evaluation of medical images. The platform is specifically designed to reduce friction in setting up and conducting image-based review tasks, particularly in research contexts. Key priorities in its development included accessibility, security, adaptability, and ease of use across diverse imaging modalities and project types through a modern, graphical interface, prioritizing ease of use.

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As imaging datasets grow in size and complexity, and as machine learning becomes more integrated into medical research, the need for scalable and user-friendly evaluation tools becomes even more pressing. Platforms that enable structured feedback without compromising data security are not only helpful — they are increasingly essential. By simplifying the process of engaging clinical experts and standardizing how feedback is collected, tools like naesView can help bridge the gap between disciplines and accelerate the pace of imaging research.

This study presents naesView, a web-based application for collaborative evaluation of medical images. The system is designed to (i) maintain data locality and compliance with data protection regulations, (ii) support flexible project configurations, and (iii) provide a reproducible framework for structured image feedback collection. The paper details the design and implementation of the platform and demonstrates its applicability in multiple research scenarios.

2. Background

Medical image annotation and evaluation tools have become increasingly important in both research and clinical workflows, especially as machine learning methods are more widely adopted. A wide range of platforms now exist, each addressing different parts of the imaging pipeline — from segmentation and labeling to review and quality control. These tools generally fall into two main categories: cloud-based platforms and local software solutions.

Cloud-based tools, such as Labelbox, and web-based viewers like Nora, offer convenience and centralized access, making them attractive for collaborative projects. However, these tools typically require that image data be uploaded to remote servers, which is often not permissible under local ethical or institutional review board guidelines, especially when handling patient data.

On the other hand, local solutions such as 3D Slicer, MITK and ViewDEX (Håkansson et al., 2010) provide powerful visualization and annotation features without requiring data transfer, thereby supporting stricter data protection. However, they lack support for parallel collaborations in an online, convenient setting often necessary for international collaborations.

Few tools effectively bridge the gap between ease of access, data locality, and lightweight collaboration. naesView is designed to fill this under-served space: a web-based, installation-free solution that allows users to review medical image datasets stored entirely on local machines, while still supporting collaborative project setup, evaluation, and structured feedback collection.

This focus on intuitive use, security, and rapid configuration makes naesView particularly well-suited for medical research environments where technical overhead, regulatory constraints, and interdisciplinary collaboration all play a central role.

3. System overview

naesView is implemented using modern JavaScript technologies, following a client-server architecture designed for flexibility, ease of use, and security. The platform runs entirely in the browser and is compatible with any operating system, requiring no installation. This enables users to begin reviewing projects immediately on any local system with access to the image data.

The core visualization functionality is powered by the CornerstoneJS library, which provides robust support for medical image formats such as DICOM and NIfTI. The user interface is built with React, allowing for a modular, responsive, and intuitive design experience across devices. All sensitive image data remains strictly local and is never transmitted or stored remotely. However, non-sensitive information—such as project configurations, reviewer identifiers, timestamps, and review outcomes—is stored securely on a remote server to enable collaboration and structured result export across users and sessions.

3.1. Supported data

naesView works with local datasets. To handle visualizing multiple files, all processed data is required to be compressed in a .zip file, which is called a dataset. Each folder within the dataset is treated completely independently, these are called cases. For the file structure see Figure 1.

Figure 1: An example dataset structure. All images must be stored in a `.zip` file.

Image loading and visualization are handled through the Cornerstone library, which supports medical image formats such as DICOM and NIfTI, as well as conventional formats like PNG and JPEG. Images are only visualized in the browser; no image data is ever transmitted or stored remotely. This ensures that patient-sensitive information remains fully local and compliant with data protection regulations.

A case consists of multiple volumes, which can be stored in different file formats or simply different folders. A volume is identified based on its corresponding path (full name for NIfTI, and name of the subfolder path for PNG/JPG and DICOM). This name can be used to select individual volumes.

3.2. User roles

naesView distinguishes between two primary user roles: The *Project Owner* who is responsible for creating and configuring projects and *Reviewers*, who are granted access to evaluate images in the configured layout. Project owners can also be reviewers.

The evaluation process in naesView begins with the Project owner who configures a project through a graphical user interface that allows to define the following customizations:

- A public title, a short description of the project and a thumbnail image.

- A private description of the project, detailing the task for the reviewers.
- A custom number and alignment of viewports for parallel visualization of multiple images. Each viewport is customizable with the following fields:
  - The alignment of the viewport (axial, sagittal or coronal)
  - The volume(s) to visualize in the viewport (the path to the volume) and whether to convert the volume to a segmentation or not.
- Feedback options for all the possible reviews allowed for the project.
- Labels that show the title of the currently viewed case, optionally split by a delimiter, showing only part of the full text. This is useful when the file name contains useful information for leaving a review.
- Optional comment fields, and an option for timing the evaluations.
- An option to allow the reviewer to manually edit a preexisting segmentation using a circular brush.

This flexibility enables the platform to support a wide range of study types—from simple classification tasks to complex multi-modal evaluations—while keeping the setup process intuitive and accessible.

Once configured, projects can be shared across the Reviewers, allowing multiple members to participate without any additional technical setup. All user interactions, including feedback submissions and timestamps, are systematically recorded, enabling structured downstream analysis. All interactions of reviewers are listed below:

- Scroll through image stacks.
- Change windowing levels, zoom and pan in any of the viewports.
- If the Project Owner enabled editing segmentations, then the reviewer can use a circular brush to edit existing segmentations.
- Leave feedback on the specific case using the predefined options.

3.3. Data security

naesView expects both Project Owners and Reviewers to have full access to the dataset. The platform does not function as a data sharing service. However, the platform keeps medical data secure by not including any sensitive information in the reviews.

To enable collaboration, all image reviews are stored on a web server. Therefore, reviews must not contain sensitive information. By default, each review stores: (1) a unique case identifier, from the position of the case in the zip file of cases, (2) an identifier for the reviewer, (3) the time of the review, (4) the elapsed time while looking at the evaluated case, and (5) the review itself (performed according to the predefined layout), optionally accompanied by a comment and/or edited segmentations as binary arrays. When the Project Owner downloads the reviews, it is possible to link the replace the case identifier with the original filename, or export reviews as-is to maintain a fully de-identified workflow.

4. Example applications

The introduced platform aims to generalize towards both medical and non-medical image assessments. However, the initial projects have primarily been connected to the development of deep learning solutions, showcasing the importance of close collaborations between deep learning developers and clinicians. Below, we describe three use cases where naesView has proved useful.

4.1. Example 1: Anatomy classification

In a clinical database, several metadata fields are stored for each image series; however, the scanned anatomical region is often not explicitly included. This information is valuable for generating statistics or retrieving images from specific body regions. To address this, the Project Owner trained an AI model to classify anatomical regions based on $32\times32\times32$ image volumes. The model's predictions were then evaluated and corrected using naesView, with all images stored in NIfTI format (.nii.gz). To assist reviewers, the predicted labels were appended to the folders containing the image data and displayed during the evaluation process using labels.

The Project Owner then configured three viewports—–axial, sagittal, and coronal—–to visualize the same volume from different orientations (Figure 2). Reviewers were asked to verify or correct the model predictions by selecting from predefined anatomical categories: *Correct*, *Head*, *Head & Neck*, *Thorax*, *Abdomen*, *Pelvis*, *Legs*, and *Whole Body*. The Reviewer then manually evaluated 14,990 scans and their model predictions.

4.2. Example 2: Prostatic zone segmentation

A deep learning-based segmentation model was developed for the segmentation of the prostatic zones from MRI images. However, the clinical validity of these segmentations needed to be evaluated. Hence, the Project Owner used naesView and saved the T2w images and the segmentations as separate NIfTI files (image.nii and mask.nii, respectively) and configured an axial viewport in naesView to overlay the segmentation mask onto the MR image. Reviewers were then asked to assess whether each segmentation required improvements. In the first evaluation round, the focus was specfically on the urethra segmentations as detailed in Figure 3.

Two reviewers independently evaluated all 55 patient cases, assessing whether each segmentation was clinically acceptable or required further refinement, Figure 3.

4.3. Example 3: Registration evaluation

For a federated learning, segmentation project using clinical data, the data quality must be ensured while also keeping it secure. In this project, four MRI sequences (T1, T1GD, T2, FLAIR) have been registered, to segment the brainstem, and other relevant structures for 112 patients. All the images are stored in DICOM (.dcm) and the project configuration is shown in Figure 4. The Project Owner configures the project such taht that all four sequences are visualized in a 2x2 grid of sagittal viewports. Reviewers were tasked with evaluating whether the multimodal registrations were acceptable and, if so, identifying whether the scan represented a preoperative or postoperative state.

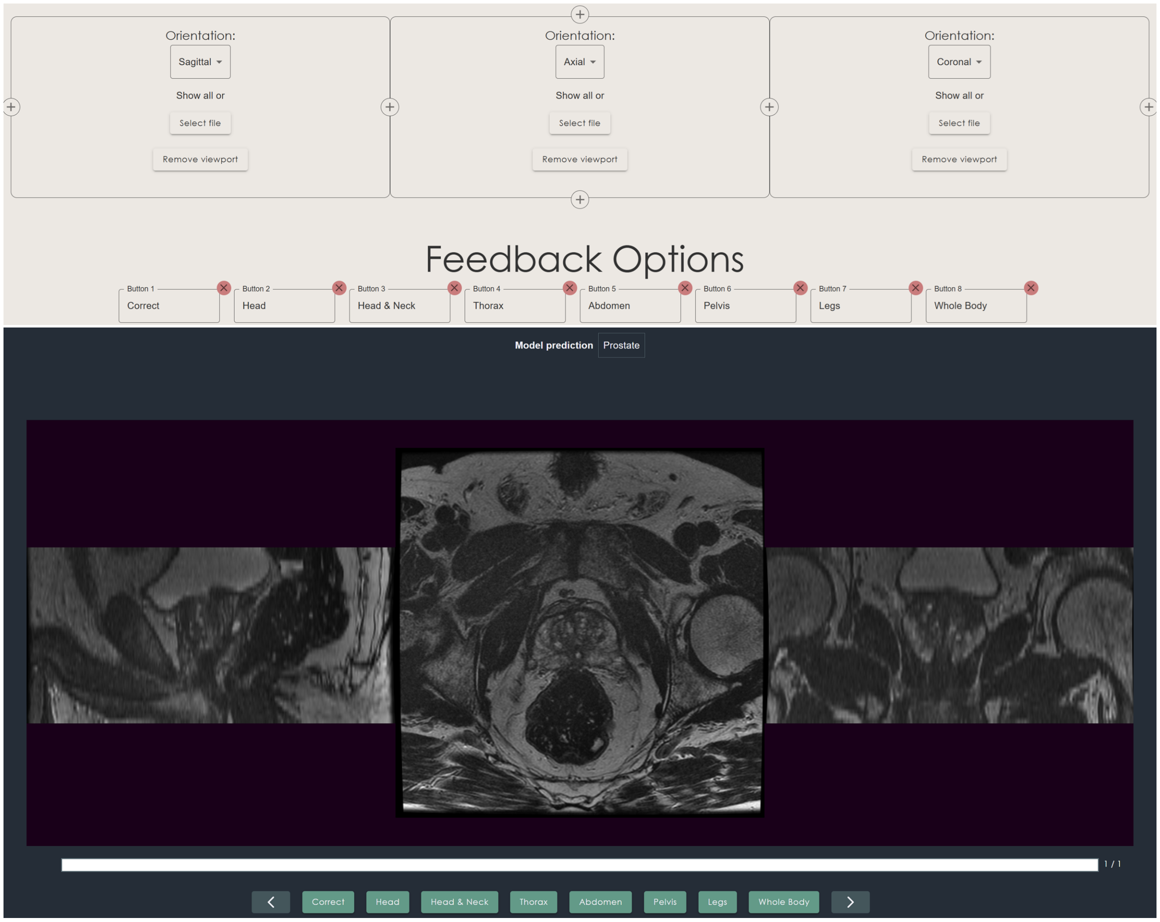

Figure 2: The configuration used for Example 1 (above) and the corresponding project view (below). Due to data sensitivity, an example from the ProstateZones (Holmlund et al., 2024) dataset is shown instead.

Reviewers then had to assess the registrations for all patients.

5. Results

In the anatomy classification task, the deep learning model achieved high accuracy, as the majority of cases were marked as "Correct" during review. For the misclassified cases, the intuitive interface made manual correction straightforward—enabling the complete review and correction of all scans in under eight hours.

In the prostatic zone segmentation project, reviewers evaluated the clinical validity of the segmentations. Poorly segmented cases were flagged and subsequently corrected. The improved segmentations were compiled into a curated, high quality dataset, which has since been made publicly available (Holmlund et al., 2024).

In the federated learning project, naesView was used to assess the quality of multi-sequence image registration for a cohort of clinical data. The initial project configuration

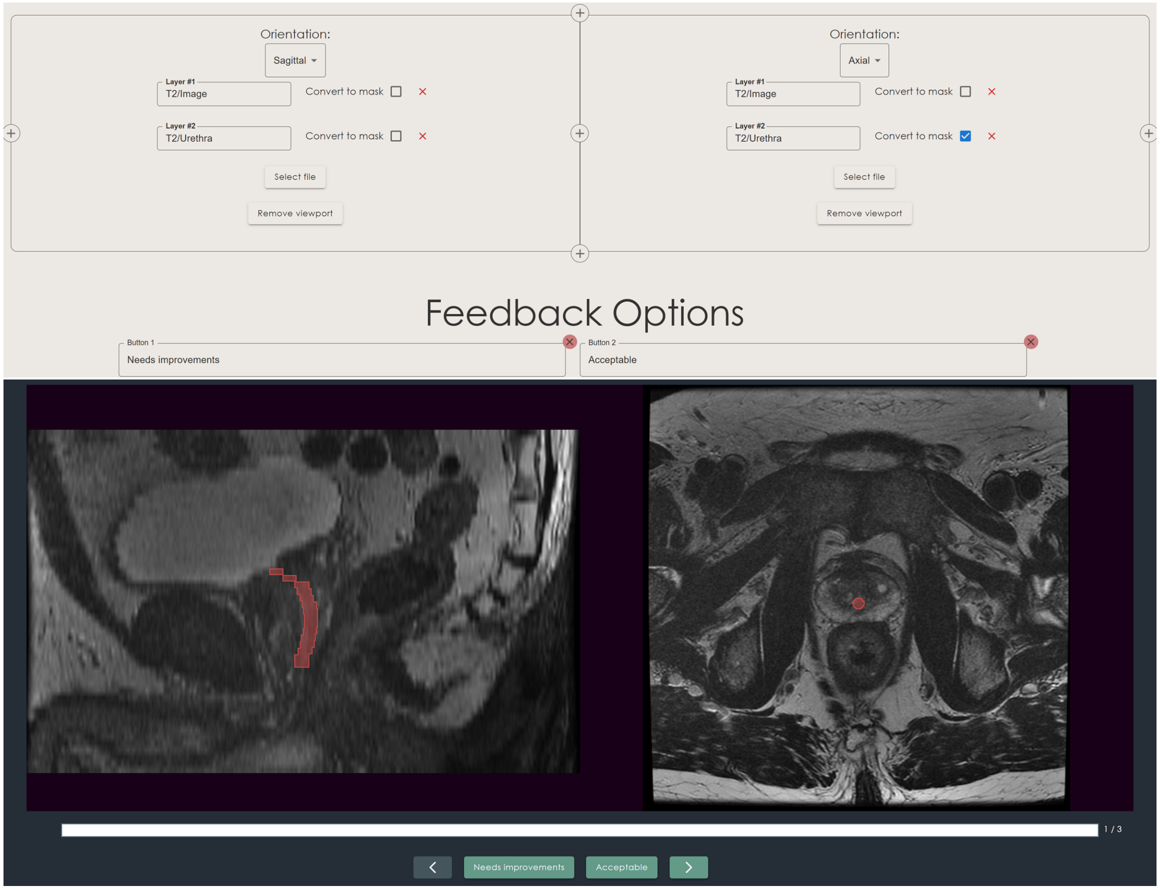

Figure 3: The configuration used for Example 2 (above) and the corresponding project view (below).

was later reused with a different dataset from another client, enabling the development team to efficiently identify and exclude poorly registered cases before model training—without reconfiguring the naesView project.

6. Discussion

The three presented examples highlight naesView's flexibility in hosting diverse research workflows. In each case, the platform's intuitive interface allowed project owners to quickly configure custom evaluation setups——whether the goal was classification, segmentation validation, or registration assessment. Notably, naesView handled a wide range of data formats (NIfTI, DICOM), imaging modalities and sequences, and evaluation types (categorical labeling, segmentation review), demonstrating its versatility across different research needs.

A key advantage of the system is its balance between ease of use and data privacy. By keeping all image data local and only storing non-sensitive metadata on a remote server, naesView enables collaborative review without the legal or institutional barriers typically

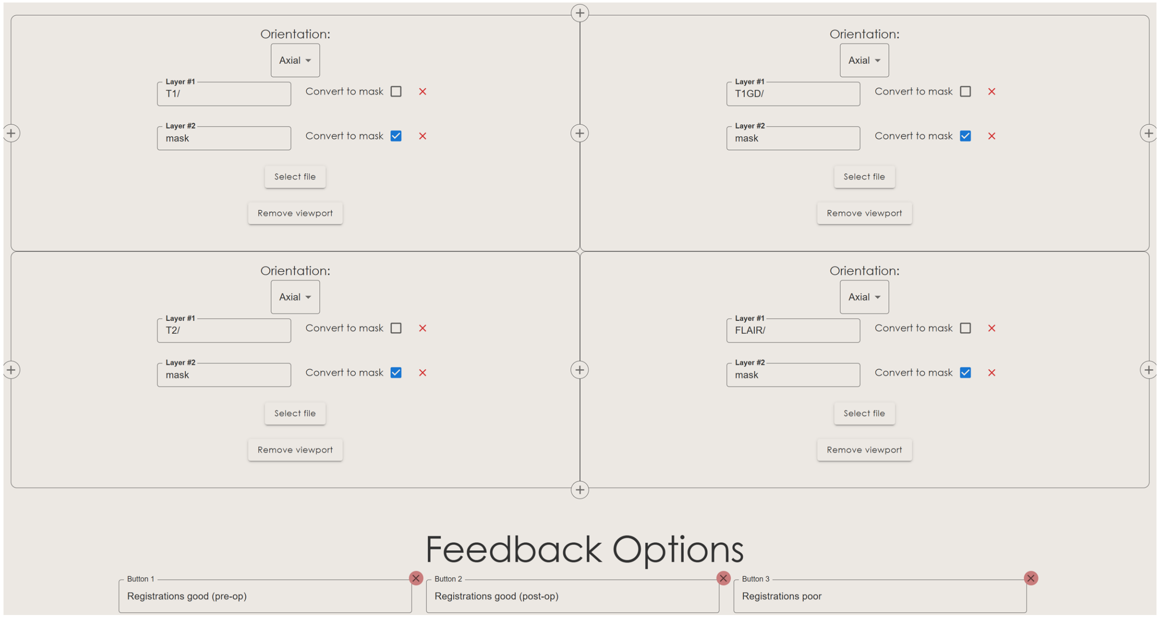

Figure 4: The configuration used for Example 3. Due to the sensitive nature of this dataset, no images will be shown of the project view of this example.

associated with centralized platforms. This feature is particularly valuable in medical research environments where data sharing is often constrained by ethics approvals, GDPR, or institutional policies.

The limitations of naesView include the absence of direct PACS integration and limited advanced editing functionality. Future work will focus on extending the segmentation toolkit, adding quantitive image analysis features and integrating federated database access while maintaining the platform's privacy-first principles.

7. Conclusion

naesView demonstrates that secure and intuitive web-based collaboration for medical image evaluation is feasible without compromising data locality. By supporting structured feedback and reproducible project configuration, the platform provides a scalable foundation for interdisciplinary research in medical imaging.

naesView is available online at https://www.naesview.com.

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