

HeartLens

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Introduction

- **HeartLens**, a pioneering venture in collaboration with **Circle Cardiovascular Imaging**, represents a significant leap forward in cardiac data analysis technology. By enhancing the existing web application's functionality with cutting-edge statistical tools and a user-focused interface, we aim to boost the analysis and interpretation of complex cardiac datasets, facilitating groundbreaking discoveries in heart health.
- Our project stands at the forefront of assisting research by offering a stunning visualization platform which will enable to bridge the data visualization gap with practical expertise. It also provides a critical solution in cardiac data management by enabling the batch processing with data across multiple studies.
- Through the visualization of aggregated data, HeartLens allows researchers to conduct in-depth longitudinal studies and compare various biomarkers. Our updated platform ensures high-quality data integrity and reliability with innovative visualizations.

Objective & Scope

- The current web application, **Vis42**, does not utilize all available data metrics, limiting visualization potential.
- Suffers from bugs, security concerns, and a non-intuitive user interface, detracting from user satisfaction.
- Introduce advanced statistical analysis and intuitive UI that will empower Circle CVI's research team with tools for comprehensive analysis of cardiac patient data.



Data Import Advancements: Improve data import by supporting XML/TXT file formats and accelerating upload speeds.



Advancing Statistical Analysis (ML): Implement ML algorithms for statistical analysis, enabling the Circle ML team perform efficient and precise cardiovascular data analysis.



UI/UX Enhancement: Revamp the UI/UX, focusing on ease of use, interactive design elements, and a more intuitive navigation structure.



Security and Scalability: Enhance website security to protect sensitive data while optimizing system architecture for scalability, ensuring reliable performance as user demand and dataset sizes increase.

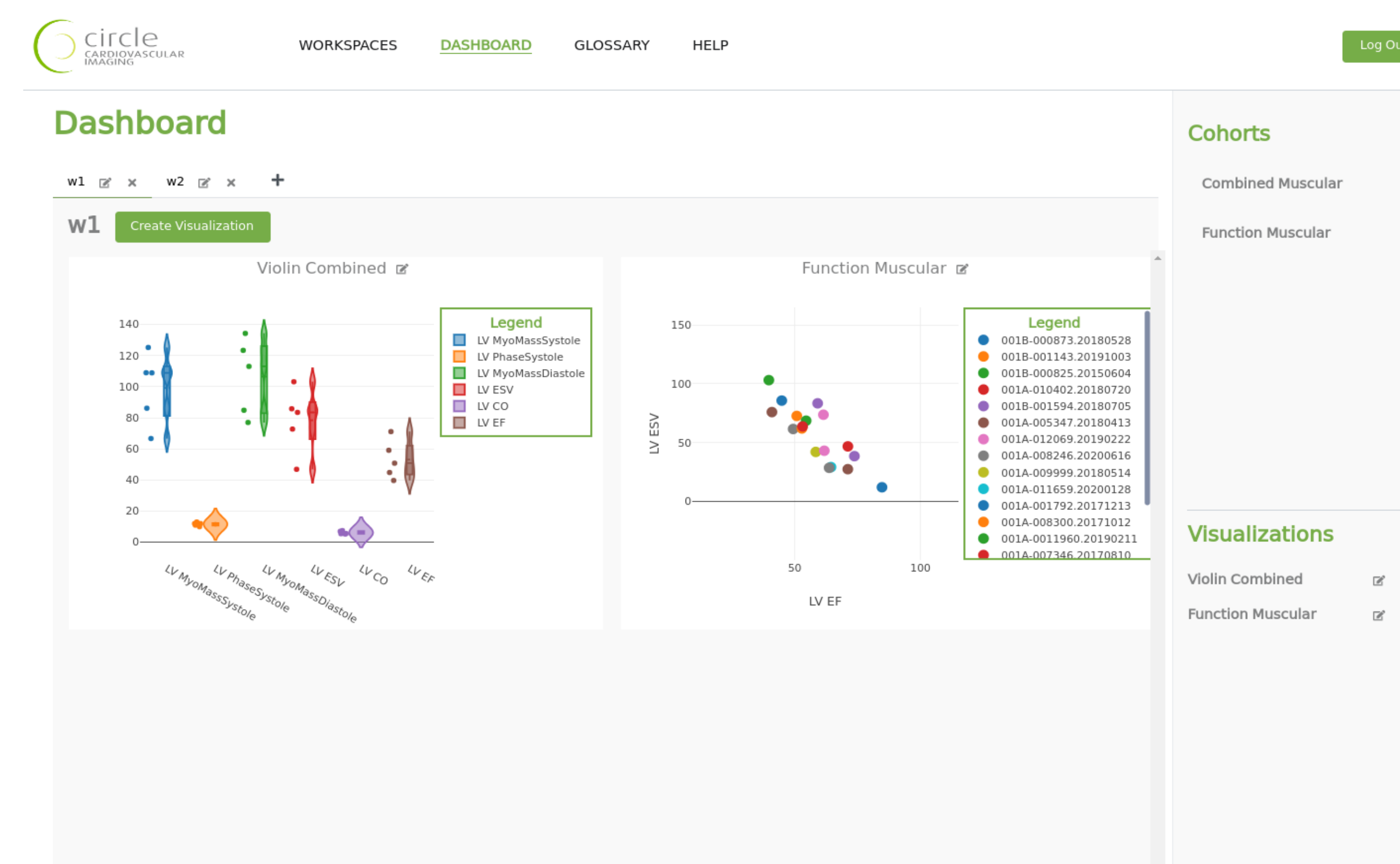
Methodology

Our team took advantage of Agile Methodologies which involved frequent communication with our sponsor to clearly define the project requirements initially. As for development, we incorporated SCRUM where we had one-month sprints. We utilized the idea of Epics, Stories and Tasks to divide tasks into smaller, concrete tasks assigned to individual team members.

- For our **development process**, we ensured quality of code with Code and QA reviews on all PRs and UI reviews on all frontend related tasks. In addition, we've implemented linters and formatters via a pre-commit hook. As an added reliability measure, we also incorporated a GitHub Action that runs the automated frontend and backend tests on every commit.
- For our **project management process**, we were in active communication with our sponsor, academic advisor and TA via various project management tools like a team calendar and team workspace. In addition, for our meetings we maintained meeting minutes documents so all our meetings were documented and could be referred to. Finally, to manage our deliverables we utilized a GANTT chart and a GitHub SCRUM project board. This helped us manage and track deliverables and easily visualize our progress.

Results

- **XML parsing** for files produced by cardiovascular scanner. Feature parity with other filetypes.
- **Over 40x speed up** to existing parser for proprietary heart scan files. (from ~10s to ~0.2s).
- **Introduced** new visualizations, which is critical for data inspection in ML.
- **Password hashing** for enhanced security.
- **UI/UX overhaul** standardizing and optimizing the user workflow.
- **Unit tests** to validate functionality in critical sections on the frontend and backend.
- **CI/CD pipeline** developed using docker compose with production/development environments, and GitHub Actions.



Conclusions

Our team has been successful in augmenting the existing web app in various domains such as UI/UX, visualization capabilities, and cardiovascular scan parsing. By utilizing advanced QA processes, we have ensured that users will get a commercial-grade application. These changes ensure that the biomedical ML researchers at Circle will be able to continue making groundbreaking discoveries in heart health.

References

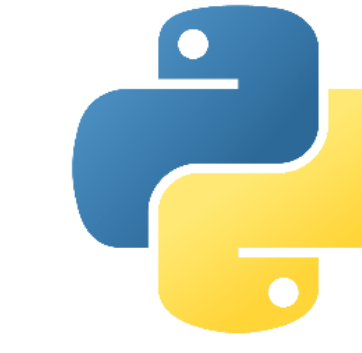
1. A. Schulz and A. Schuster, "Visualizing diastolic failure: Non-invasive imaging biomarkers in patients with heart failure with preserved ejection fraction," eBioMedicine, vol. 86, pp. 1-13, Nov. 2022. [Online]. Available: <https://doi.org/10.1016/j.ebiom.2022.104369>
2. M. A. Peterzan, O. J. Rider, and L. J. Anderson, "The Role of Cardiovascular Magnetic Resonance Imaging in Heart Failure,". Cardiology Clinical Academic Group, St George's Hospital, London, UK; University of Oxford Centre for Clinical Magnetic Resonance Research, John Radcliffe Hospital, Oxford, UK.



TypeScript



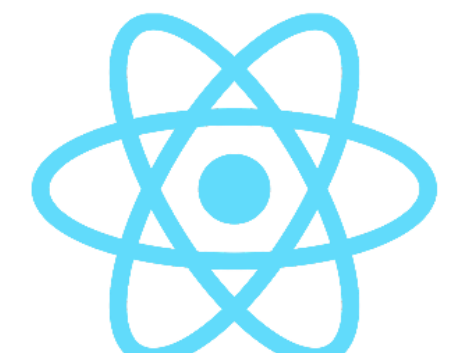
Docker



Python



SQLite



React

Challenges

In the dynamic process of HeartLens' software development throughout the school year, many challenges emerged, presenting hurdles our team had to navigate to ensure the project's overall success.

- **Defining measurable deliverables** stood as a cornerstone for initially aligning our efforts and tracking useful progress along the way.
- **Cross-platform issues** further complicated matters, demanding solutions that cater to the diverse technological environments in the team (Windows, MacOS, Linux).
- **Time management** also became very important, as our team strived to meet the set deadlines while still maintaining quality.
- One of the most dangerous challenges was **scope creep**, where evolving requirements threatened the project's stability as time moved forward.

CONTACT INFORMATION

