Reflection and Traceability Report on SFWRENG 4G06A

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April 4, 2025

Contents

1 Changes in Response to Feedback

This section summarizes the changes we have made in regards to the feedback we got from TAs, supervisor, peer review, supervisor, and during usability testing. The changes made can be found in the below able by clicking on associated issues. In order to ease the traceability we have categorized the issue into milestones such as 'TA Feedback Issues', 'Peer Review', and 'Final Doc Updates' which can be found in Team-25's Capstone Deliverables Project. Associated PRs for issues can be viewed under specific views created for TA feedback, Peer review, and Final documentation updates issues.

1.1 SRS and Hazard Analysis

Changes to SRS and Hazard Analysis along with the feedback, response, and associated issues can be found in the tables below:

Table 1: Changes for SRS Documentation

Feedback Source	**Feedback Item**	**Response**	**Issue**
TA	Document Content: Missing revision history; Document Organization: Incorrect template; LO Ext. Knowledge: No mention of feedback from supervisor; LO Formalization: Missing formalization and other sections related to data types, etc.	Template updated to include all relevant sections, including formalization. External knowledge from supervisor added. Revision history updated.	#166
TA	Formatting and Style: Grammar and capitalization errors; Focus on Users: Issues with stakeholder and user section; Phase In Plan: Missing phase-in plan; LO Impact: Impact on society is not clear.	Fixed grammar and capitalization errors. Updated stakeholders and users section. Society is listed as a stakeholder along with impacts on health, safety, cultural diversity, etc. Phase-in plan added.	#167
TA	Notations and Conventions: Use case diagram missing labels.	Use case diagram updated.	#168
TA	What not How (Abstract): Constraints listed as requirements; Basis for Design: Vague constraints, HIPAA included which is not applicable; LO Standards: Vague requirements.	Constraints and NFRs updated to address issues. Compliance is changed to PIPEDA.	#169

Feedback Source	Feedback Item	Response	Issue
TA	Complete, Correct, and Unambiguous: Unclear requirements; Traceable Requirements: Incorrect traceability matrix; Verifiable Requirements: Unclear fit criterion.	Outlined requirements and reworded fit criterion. Traceability matrix fixed.	#170
Peer Review	Unclear Requirements for Accessibility Compliance.	Requirement removed as a result of changed scope.	#79
Peer Review	Missing Phase-in Plan.	Added as a result of TA feedback.	#80
Peer Review	Vague Specification for Functional Requirements.	Requirements reworded.	#81
Peer Review	Complete, Correct, and Unambiguous Criteria: Functional Requirements not properly worded.	Reworded functional requirements.	#82
Peer Review	NFRs: Gap in Data Backup and Recovery.	NFRs reworded and updated.	#83
Peer Review	Requirements for System Scalability lack details.	NFR reworded and updated.	#84
Design Changes	NA	Requirements for AI Assist, feedback messages, and other design changes were added.	#402

Table 2: Changes for Hazard Analysis

Feedback Source	Feedback Item	Response	Issue
TA	Spelling, grammar, and style: FMEA table formatting.	Formatting fixed.	#171
TA	Recommended Actions: Mention user involvement in assumptions.	Assumptions updated.	#172
Peer Review	Missing Requirements: Missing some of the requirements such as security, etc.	Requirements included in SRS.	#103
Peer Review	Scope and Purpose of Hazard Analysis: API modules need more robust solutions.	Details of robust solutions added.	#104
Peer Review	FMEA table does not account for formatting issues in classification.	Potential hazard added in the table.	#105
Peer Review	Roadmap lacks clarity.	Roadmap updated for clarity to include how iterative feedback would be used.	#106

Feedback Source	Feedback Item	Response	Issue
Peer Review	Access requirements do not address how the system will handle repeated failed login attempts.	Access requirements reworded to handle repeated login attempts.	#107
Peer Review	Detection gaps in FMEA table.	Measures added for data accuracy and consistency.	#108
Design Changes	NA	Components updated and usability survey updated according to design changes.	#403

1.2 Design and Design Documentation

Changes to Design and Design Documentation along with the feedback, response, and associated issues can be found in the tables below:

Table 3: Changes for Design

Feedback Source	Feedback Item	Response	Issue
Supervisor	Add functionality for uploading and creating prescriptions.	Created the functionality to create prescriptions. The feature was not fully developed as per feedback in Rev 0 demonstration to prioritize more important aspects of the project.	#295
Supervisor	Add functionality for uploading and creating referrals.	Created the functionality to create referrals. The feature was not fully developed as per feedback in Rev 0 demonstration to prioritize more important aspects of the project.	#294
Supervisor, TA, Professor	Functionality to query patient profiles.	Implemented AI-Assist to achieve this functionality.	#381, #384
Usability Testing	Add disclaimers for predictions.	Implemented clear disclaimers when providing treatment plans and diagnosis predictions.	#426
Usability Testing, Peers	Add confirmation modals and appropriate feedback messages.	Implemented confirmation modals and toast messages to provide feedback to the user.	#427

Table 4: Changes for MG and MIS

Feedback Source	Feedback Item	Response	Issue
TA	SoftArchitec: Quality Information: Some secrets are not secrets and should be updated.	Updated to clarify the information.	#419
TA	DetDesDoc: EnoughToBuild: Vague and ambiguous wording.	Clarified wording for better understanding.	#420
TA	CI/CD Infrastructure: Not working, actions failing.	CI/CD fully set up with no issues.	#421
TA	LO SpecMath: No specific feedback provided.	Already formalized to the best of our ability.	#422
TA	LO ProbSolutions: No specific feedback provided.	Already completed to the best of our ability.	#423
TA	LO Explores: No specific feedback provided.	Already completed to the best of our ability.	#424
Peer Review	Module Guide: Secrets for patient model and administrator model do not cover data validation, consistency rules, and any internal logic hidden from other modules.	Minor changes added; the main secret is mentioned, and data validation is inferred as a function.	#249
Peer Review	MG: Insufficient Detail on Relationships Between Modules.	Provided details in the network sections, including HTTP and sockets.	#250
Peer Review	MIS: Missing Details in Assumptions for Prediction Modules.	Updated assumptions to include edge cases, such as handling missing or invalid data in the input chart.	#251
Peer Review	MIS: Missing Error Handling Details in Broker Module.	Added details on how the Broker Module handles module-level failures.	#252
Peer Review	MG: Lack of Integration Details for Administrator Account Management.	Included a description of the request/response structure for the CRUD operations and specified validation requirements for API calls.	#253
Design Changes	NA	MG and MIS updated to reflect the updated design, including added components like the AI-Assist module, etc.	#405

1.3 VnV Plan and Report

Changes to VnV Plan and Report along with the feedback, response, and associated issues can be found in the table below:

Table 5: Changes for VnV Plan

Feedback Source	Feedback Item	Response	Issue
TA	Content: Broken entry in references.	Reference issue fixed.	#190
TA	Spelling, grammar, and style: Break into paragraphs such that one paragraph discusses one topic.	Formatting fixed.	#191
TA	Plan: VnV Reviews issues.	Updated to remove mutation testing and include a checklist.	#194
TA	System Tests for Functional Requirements are specific: Issues in input and error messages.	Provided concrete inputs and error messages.	#197
TA	Tests for Nonfunctional Requirements are specific: Vague tests.	Updated tests to include specific details.	#198
TA	Nondynamic testing used as necessary: Details missing for static testing.	Added details for static testing and fixed errors.	#200
Peer Review	General Information: Lacks clarity in its objectives.	Updated to emphasize the critical nature of safety and security in healthcare applications.	#137
Peer Review	Usability survey: Does not include specific and open-ended questions.	Usability survey updated to include tailored questions to collect data on various design components.	#138
Peer Review	Implementation Verification Plan: Does not provide clear criteria for identifying "critical sections."	Updated to include a checklist to identify critical sections.	#139
Peer Review	Tests for functional requirements: Lacks details on error messages.	Updated output to include specific details in error messages.	#140
Peer Review	Static Testing Procedures: Lacks a structured approach.	Static Testing Procedures updated to include a structured approach and a checklist.	#141
Peer Review	Software Validation Plan: Lacks specific criteria for validating the software against stakeholder expectations.	Updated to include specific criteria to validate software.	#142
Design Changes	NA	VnV Plan updated to add tests for AI-Assist, updated existing tests to meet the final implementation design.	#404

Table 6: Changes for VnV Report

Feedback Source	Feedback Item	Response	Issue
Peer Review	VnV Report: Verification of Nonfunctional Requirement 1 is missing.	Results from usability testing included.	#357
Peer Review	Report has grammar and spelling issues.	Updated to fix grammar and spelling.	#358
Peer Review	VnV Report: Insufficient Explanation for Deviations from the VnV Plan.	Both VnV Plan and Report updated to include changes due to updated requirements. Any deviations are fully explained.	#359
Peer Review	VnV Report: Shallow Safety and Security Testing.	Updated safety and security requirements to include specific criteria and match updated requirements.	#360
Peer Review	VnV Report: Revision history not updated.	Revision history updated to include details.	#361
Peer Review	VnV Report: Undefined Pass/Fail Criteria for Voice-to-Text Transcription.	Tests updated to include specifics. Also covered as part of unit testing.	#362
Design Changes	NA	VnV Report updated to add test results for AI-Assist, and test results for updated tests from VnV Plan to meet the final implementation design.	#404

2 Challenge Level and Extras

2.1 Challenge Level

The challenge level for the project is **General** as agreed upon by the course instructor. This classification perfectly reflects the project's scope and complexity.

2.2 Extras

The extras that were took by this project are usability testing and user manual. In usability testing, the participants were given some task instructions to test the system. Post task, they were required to fill a survey to rate their experience with the system. The participants also gave some suggestions for future improvements in the system. Additionally, a user manual is a technical document that is provided to assist people in using this project. It contains detailed description of each feature of the system as well as instructions on how to use it.

3 Design Iteration (LO11 (PrototypeIterate))

The journey from the first version to the final version was a driven by the iterative feedback from the supervisor, TA, peers, other stakeholders, and the professor.

Initially, the goals were defined in the problem statement and the initial set of requirements was laid out in SRS. After meeting with the supervisor and hospital tour, we updated our goals and some requirements to introduce new features that will distinguish this project with the EHR that is being used currently in the healthcare industry. We showcased our system before the Proof of Concept demo to our supervisor to gather her feedback and following that we included the necessary features in the system. Post that, we showcased our POC demo to the TA and the supervisor to explain how will we mitigate the potential risks associated with the modules. After gathering the feedback from the supervisor, TA and the professor, we made a list of the features that we will be priortizing before Rev 0 demo. The initial UI design was prepared in figma for both MG and MIS and the tests were prepared in VnVPlan. We also performed the usability testing with the initial version with our peers and our supervisor. To prepare for Rev 0 demo, we completed most of the requirements stated in SRS and also performed an initial testing of the UI. Following that, we showcased our system before the Rev 0 demo to our supervisor and adding two additional functionalities, i.e., Referrals and Prescriptions to further enhance the features of our system. Then we did our Rev 0 demo with the TA and professor. Based on their feedback, we added another functionality which is AI-assistance to help healthcare professionals load and query patient data. We also re-structured unit tests along with improving the accuracy for transcription and classification services. After improving the accuracy, we showcased our project to the supervisor and did usability testing with the updated system. Following her feedback, we added the disclaimer to the UI in the footer section. Therefore, the final product is a result of iterative process as explained above.

4 Design Decisions (LO12)

Reflect and Justify Design Decisions.
Our design decisions from the start were heavily focused around the single responsibility principle. On the module level, we wanted the system to be extendable around the service layer, as microservices could be added easily. This allows for easily extension, and maintainability for the scope of the project.

Additionally, using a modular framework like ReactJS, even the frontend was built in a modular fashion. This design also was easy to test as each module having a single responsibility and single endpoint. This meant the tests could be clear and concise, this inturn made the VnVReport clear and easy to understand.

How did limitations,assumptions, and constraints influence your decisions?
The number one assumption of low load influenced our design. When the application is up each microservice only has one worker running. If we assumed for a larger load, we could have added more worker, which would entail adding a load balancing module.

Another assumption that influenced our design was the access to data hierarchy. What we mean by this is we limited the scope by addressing all of the healthcare admin as one entity, and all healthcare professionals as 1 entity. This inturn simplified our database rules in our data layer

module.

Lastly, we had a resource limitation interims of budget. Having an LLM based application incurs API costs. We chose to build a light weight applications with cheaper models. If the budget of the project increased we would have added a distributed, decentralized vector store for more efficient retrieval for our LLMs.

5 Economic Considerations (LO23)

There is a clear market for our product, RapidCare. The healthcare industry, particularly in Ontario, is facing an overwhelming documentation burden due to a shortage of family doctors, affecting over 2.5 million patients. Our solution automates healthcare documentation through voice-to-text transcription and ML-based diagnosis and medication suggestions, targeting hospitals and clinics to improve efficiency and reduce wait times.

Marketing the product would involve outreach to healthcare networks and hospital systems, emphasizing the benefits of reduced documentation overhead, improved patient throughput, and clinician satisfaction. Usability testing and comprehensive user documentation are already part of the project deliverables to aid adoption.

We have estimated the cost to produce and maintain a market-ready version at $500 per month. Each subscription will place us in a net positive, making the business model financially sustainable from the first sale.

Our current strategy involves direct outreach to hospital IT departments, leveraging existing connections to secure early adopters and drive initial growth. The potential user base includes doctors, nurses, and administrative staff across healthcare institutions, particularly those involved in clinical documentation. Given Ontario's reported shortage and the size of its healthcare system, there are thousands of potential users.

6 Reflection on Project Management (LO24)

6.1 How Does Your Project Management Compare to Your Development Plan

We followed the development plan closely. Team meetings were held weekly, with agendas, minutes, and action items tracked via GitHub issues. Microsoft Teams was used for communication, and GitHub Projects was used for documentation, code reviews, and task tracking. The technologies planned were all implemented as expected.

6.2 What Went Well?

- Clear team roles and responsibilities helped maintain accountability.
- GitHub Projects provided an effective workflow.

- Code review and peer feedback ensured quality control.

6.3 What Went Wrong?

- The variability in healthcare documentation between institutions posed elicitation challenges.
- Integration testing was limited during early phases and could have been started earlier.

6.4 What Would You Do Differently Next Time?

- Increase stakeholder engagement throughout mid-development milestones.

7 Reflection on Capstone

7.1 Which Courses Were Relevant

The following courses were highly relevant to our capstone project:

- SFWRENG 3DB3 - Databases.
- ENGINEER 3PX3 - Integrated Engineering Design Project 3.
- SFWRENG 3A04 - Software Design III.
- SFWRENG 4HC3 - Human-Computer Interfaces.
- SFWRENG 4AL3 - Applications of Machine Learning.

7.2 Knowledge/Skills Outside of Courses

We had to acquire several skills beyond what was covered in our coursework:

- OAuth 2.0 and secure authentication practices.
- Domain-specific knowledge about healthcare documentation and medical terminology.