Reflection and Traceability Report on Plutos

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1 Changes in Response to Feedback

1.1 SRS and Hazard Analysis

Table 1: SRS Issues

Issue Number	Source	Issue Title	Addressed?	PR	Comments
105	TA	docs(SRS): Include formal/math specs	✓	300	Added formal math specifications in SRS for OCR model, data constraints, budget calculation and receipt/receipt item data definitions
106	TA	docs(SRS): Add section for ”normal operation”	✓	317	Added section for normal operation and use case diagram
107	TA	docs(SRS): Add section for undesired event handling	✓	308	Added section
108	TA	docs(SRS): Add fit criterions to requirements	✓	310	Added fit criterions
109	TA	docs(SRS): Link requirements to rationale section	✓	303	Linked requirements to rationale section
110	TA	docs(SRS): Link likely and unlikely changes to requirements	✓	303	Linked requirements to un/likely changes
38	Peer Review	peer-review[team 23]: OCR system accuracy	✓	–	This was a question, which was answered as a comment in the issue.
39	Peer Review	peer-review[team 23]: OCR pipeline privacy	✓	–	This was a question, which was answered as a comment in the issue.
40	Peer Review	peer-review[team 23]: release platform	✓	310	Changes made
41	Peer Review	peer-review[team23]: Non-Functional Requirements Verifiability	✓	179	Added details to requirements
42	Peer Review	peer-review[team 23]: Ambiguous Response Time Specifications	✓	179	Added details to specifications
43	Peer Review	peer-review[team 23]: Item Recognition and Categorization Requirements	✓	299	Slightly reworded requirements to make them more clear, but the issue was more of a clarification question than feedback
44	Peer Review	peer-review[team 23]: Data retention and Deletion Policies	✓	179	Added more details on policies

Table 2: Hazard Analysis Issues

Issue Number	Source	Issue Title	Addressed?	PR	Comments
111	TA	docs(hazards): Add list of tables	✓	288	Added table
112	TA	docs(hazards): Put constants in constants section	✓	288	Refered to symbolic constants
113	TA	docs(hazards): Fix hazard recommended action	✓	299	Changed recommended action
51	Peer Review	Peer Review (hazards) - Expand Analysis on External System Interactions	✓	311	Added assumption for external systems
52	Peer Review	Peer Review (hazards) - Enhance Network Failure Handling and Data Integrity Measures	✓	185	Added more details
53	Peer Review	Peer Review (hazards) - Improve Hazard Mitigation User Feedback	✓	–	Was already addressed, left comment on issue
54	Peer Review	Peer Review (hazards) - some assumptions needed for user end equipment	✓	187	Added suggested assumptions
55	Peer Review	Peer Review (hazards) - concern about problem resolvement	✓	187	Added suggested changes

1.2 Design and Design Documentation

Table 3: Design Doc Issues

Issue Number	Source	Issue Title	Addressed?	PR	Comments
233	TA	docs(design): add tests to CI	✓	262, 264, 258	Added tests to CI
234	TA	docs(design): DetDesDoc syntax - change naming and data types	✓	247	Added suggested changes
235	TA	docs(design): DetDesDoc syntax - add transaction class	✓	313	Updated design docs
236	TA	docs(design): DetDesDoc semantics - add more details to ML/categorization module	✓	247	Added details
237	TA	docs(design): DetDesDoc semantics - add details about calculations	✓	247	Added math specification
238	TA	DetDesDoc semantics - add state diagram	✓	302	Added state diagram to Figma
239	TA	DetDesDoc semantics - add 'main' UI module	✓	302	Adjusted DAG diagram and added Main UI module to module hierarchy and DAG
240	TA	DetDesDoc semantics - exception handling specs	✓	302	Added exception handling section for item misclassification
158	Peer Review	Module hierarchy diagram Link Issue	✓	302	Adjusted DAG diagram
159	Peer Review	OCR Processing Module Issue	✓	302	Added exception handling section for OCR module
160	Peer Review	Peer Review - Limited Discussion on Module-Level Secrets	✓	313	Added module secrets to image processing and categorization modules
161	Peer Review	Peer Review - Limited Error Handling Descriptions	×		
162	Peer Review	Peer Review - Ambiguity in Access Routine Semantics	×		
163	Peer Review	Peer Review - Hyperlink in section 5	✓	186	Fixed

1.3 VnV Plan and Report

Table 4: VnV Plan Issues

Issue Number	Source	Issue Title	Addressed?	PR	Comments
118	TA	docs(vnv): add captions for tables	✓	241	Added captions
119	TA	docs(vnv): add to testing plan	✓	290	Adjust functional testing criteria.
120	TA	docs(vnv): system tests for FRs	✓	290	Adjust control of system tests.
121	TA	docs(vnvplan): specify usability survey as extra	✓	–	Switched Extra2 to user manual
71	Peer Review	Peer Review - Acronyms table missing content	✓	188	Added missing acronyms
72	Peer Review	Peer Review - Enhance Usability and OCR Accuracy Test Scenarios	✓	188	Added details
73	Peer Review	Peer Review - Incomplete Error Handling and Recovery Test Cases	✓	194, 197	Added more details
74	Peer Review	Automated Testing and Verification Tools	×	–	Daily sanity checks aren't necessary as we are running the tests and linter pipelines on every PR. This will ensure that the app/features work seamlessely after every change.
75	Peer Review	Load Testing for Concurrent Users	✓	–	Already addressed in initial version of VnVPlan 'Performance tests can be conducted to measure the app's speed and reliability, especially when processing large receipts or handling multiple users'.
85	Peer Review	Peer Review - Enhance Testing for Data Persistence During App Crashes	✓	312	Added Usability Test to cover data retention during unexpected crashes.

Table 5: VnV Report Issues

Issue Number	Source	Issue Title	Addressed?	PR	Comments
304	TA	docs(vnv report): add more details to verifiability of tests	✓	316	Add specific test details
265	Peer Review	Peer Review - The lost xlsx file in hyperlink	✓	291	Fixed
266	Peer Review	Missing Functionality	✓	306	A couple of the FRs weren't implemented yet during the initial draft of VnVReport - they have now been implemented. As for account update and notifications, we felt that for the scope of the project, these functionalities would be able to be implemented later.
267	Peer Review	Reduced accuracy	✓	306	Added more reasoning as to why we decreased accuracy threshold.
268	Peer Review	Reduced accuracy	✓	316	Multiple NFRs have already been tested (NFR-ACC-1, NFR-ACC-3, NFR-MTB-1) before this issue. Added details to some more NFRs in new PR.
269	Peer Review	Lack of Detailed Analysis for Performance Test Omissions	✓	318	Added rationale to test case omission
270	Peer Review	Unclear Implications of Security and Legal Compliance Testing	✓	309	Added more details

2 Challenge Level and Extras

2.1 Challenge Level

The expected challenge level is **general**. The primary challenge of the project is developing a machine learning model that can accurately parse items from a picture of a receipt, and to categorize them into appropriate spending categories. This requires a strong understanding of training and tuning models on image data to achieve high accuracy. Additionally, different items across various stores may have similar names or be difficult to recognize, which adds to the complexity of the task. The other part of the project is to develop a user-friendly mobile application, which is a more general software engineering component.

2.2 Extras

1. **Requirements elicitation report**: We have conducted interviews and a survey to gather requirements from potential users to determine user needs and preferences, and document the findings in a report. See Requirements Elicitation Report.

2. **User manual**: We have created a user manual to help users understand how to use the application and its features. See User Manual.

3 Design Iteration (LO11 (PrototypeIterate))

[Explain how you arrived at your final design and implementation. How did the design evolve from the first version to the final version? —TPLT]

[Don't just say what you changed, say why you changed it. The needs of the client should be part of the explanation. For example, if you made changes in response to usability testing, explain what the testing found and what changes it led to. —TPLT]

4 Design Decisions (LO12)

[Reflect and justify your design decisions. How did limitations, assumptions, and constraints influence your decisions? Discuss each of these separately. —TPLT]

5 Economic Considerations (LO23)

There is a clear growing market for budgeting and personal finance tools, especially amongst university students and young adults. Young adults often face financial challenges during their early years of living independently, and are also often unaware of the costs of living, driving the need for budgeting tools. However, being university students and young adults ourselves, we understand the barrier to entry to start budgeting is high. As well, current budgeting tools are often too complex and overwhelming for young adults to use, which is what drives the need for Plutos – a simple yet effective way to track expenses and budget using receipt photo scanning.

Marketing Plutos would involve a combination of digital outreach and grassroots efforts. This could include social media advertising (especially on platforms like Instagram and TikTok), collaborations with student organizations, and targeted campaigns during back-to-school periods. Additionally, in-person promotion at campus events and integration with student services at universities could help increase visibility and adoption.

Since the overhead cost of developing and maintaining Plutos is low, we would host the product on Google Play Store and Apple App Store for free because we understand students wouldn't want to pay for a budgeting tool. However, we would offer a premium tier to allow users to utilize additional features such as advanced analytics, bank account integration, budgeting suggestions and exporting budgeting data to a PDF or CSV. We estimate the cost of premium services to be \$1.99/month and with 105 monthly users, we'd be able to make money and cover the costs of maintaining the app (since the app is low cost and will only require \$210/month to operate).

We believe this target is feasible as we have already surveyed 20 students and all of them expressed interest in using Plutos. With a potential user base of 40,000 students just at McMaster University alone and our marketing plan, we believe that everyone can use Plutos immediately.

6 Reflection on Project Management (LO24)

6.1 How Does Your Project Management Compare to Your Development Plan

Our team followed the development plan as outlined in the SRS Development Plan section. We adhered to the planned meetings, communication methods, assigned roles, and workflow structure. The project was structured into phases, and we prioritized high-priority functional requirements as scheduled. While some deadlines were subject to change, we adapted accordingly to ensure steady progress.

At the start of the project, we had a general idea of using an OCR model to extract data from receipts, but we weren't committed to a specific tool. Throughout the development process, we experimented with a few different OCR models to see which one would work best for our needs. After testing and comparing results, we ultimately decided to use Tesseract, which is an open-source OCR engine developed by Google.

Tesseract provided the balance we were looking for in terms of accuracy and ease of integration. While some of the other models we tried had certain strengths, Tesseract performed consistently across a wide range of receipt types, and it was easier to work with in our app's pipeline. Even though we didn't plan on using it from the beginning, the decision to pivot toward Tesseract ended up being a good one for the project.

6.2 What Went Well?

Our capstone group worked well together, maintaining strong organization and collaboration throughout the project. Meetings and clear communication ensured that everyone stayed on track with their tasks. Each team member effectively contributed to their assigned roles, which helped keep development on schedule.

A key success was the OCR model used to parse receipts. It met our expected accuracy, allowing us to extract and categorize receipt data effectively. This was essential for the project's goal of creating an innovative expense-tracking budgeting app.

6.3 What Went Wrong?

Like any project, we encountered some challenges along the way. There were occasional difficulties in coordinating schedules, especially when balancing coursework with project deadlines.

In terms of workflow, there were moments where certain tasks took longer than expected due to debugging and integration challenges. However, the team adapted and adjusted the timeline as needed.

In terms of tools, one of the main challenges was our initial unfamiliarity with OCR models. Since most of us had limited prior experience working with OCR technology, there was a learning curve when it came to understanding how different models worked, how to train or fine-tune them, and how to handle various types of receipt formats. It took time to experiment with different models and figure out how to integrate them into our pipeline effectively.

6.4 What Would you Do Differently Next Time?

For future projects, we would aim to refine our approach to time management by setting aside more buffer time for debugging and testing. While our communication was strong, we could improve further by implementing more structured progress tracking to ensure that any potential delays are addressed earlier.

7 Reflection on Capstone

[This question focuses on what you learned during the course of the capstone project. —TPLT]

7.1 Which Courses Were Relevant

[Which of the courses you have taken were relevant for the capstone project? —TPLT]

7.2 Knowledge/Skills Outside of Courses

[What skills/knowledge did you need to acquire for your capstone project that was outside of the courses you took? —TPLT]