VCU College of Engineering

CS-25-323 Modular Feedback

Project Proposal

Prepared for

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Executive Summary

The Modular Feedback project aims to develop an innovative system for collecting feature-specific user feedback at Capital One. The project addresses the need for a more efficient and detailed method of gathering user opinions on various platform features, an area where traditional feedback mechanisms, such as surveys and forms, fall short due to low response rates and generalized feedback.

Given Capital One's diverse user base there is a significant challenge in collecting targeted feedback in a scalable manner. The proposed solution will introduce a modular web component, allowing users to provide quick sentiment-based feedback via a "thumbs up" or "thumbs down" mechanism. This feedback will be integrated with Clickstream analytics, enabling deeper insights into user behavior and feature engagement. The system will also include an admin dashboard to track feedback, monitor trends, and customize the implementation as needed.

The project's key objectives include improving Capital One's existing feedback mechanisms by creating a user-friendly interface for users to provide feedback, and building a robust database for tracking and storing that feedback. The system will be designed to be easily scalable, secure, and compliant with accessibility and security standards.

The project will be delivered in two iterations, with the first focusing on the implementation of the basic feedback module and Clickstream integration, while the second iteration will introduce advanced features such as text input for feedback and an administrative interface for data analysis. By providing a modular and adaptable system, this project will equip Capital One with the tools to continuously improve user experience, enhance engagement, and maintain a competitive edge in the market.

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Section A. Problem Statement

In today's ever evolving world of technology, it is important for platforms to be continuously adaptable to user needs and any problems that may arise with them. Businesses and organizations want to know consumers' opinions about their products and services [4] to make changes accordingly. A significant challenge faced by development teams is finding a way to gather feature-specific feedback from consumers to make changes and improvements where they are needed. As this scales to an enterprise like Capital One, a leading financial institution with over 100 million diverse users [1], it becomes increasingly difficult to gather feature-specific feedback in an efficient manner.

The problem at hand is the absence of a streamlined solution to be used in collecting and analyzing feedback on specific features. Currently, platforms may gather general user feedback through surveys and feedback forms. These methods often suffer from limitations such as low response rates, as mentioned in Human Relations, "low response rate in particular, is one of the… most frequently raised concerns regarding research design." The effect low response rate has on research design is also seen in feedback gathering tools. These methods lack mechanisms that focus specifically on the performance and reception of individual features, limiting an enterprises ability to understand what elements of a feature are working properly and which are needing improvement.

This problem has impacts on product managers, developers, UI teams, and others who rely on clear and actionable feedback to iterate new design features and functionality. It is mentioned in *Usability Engineering: Industry-Government Collaboration for System Effectiveness and Efficiency* that, "A significant cause of poor usability in the product stems from a lack of understanding of the development process." Without a structured feedback mechanism to help direct the development process, these teams may end up relying on data that does not accurately represent a problem, resulting in design decisions that might not be the best fit for a feature. Furthermore, the same article mentions that a participant's motivation to complete a survey may increase the validity of the feedback provided [3]. To ensure quality and actionable feedback, it is essential for us to create a feedback system that encourages users to participate.

A standardized feedback collection system would allow enterprises to track user behavior and gather feedback across multiple features or products. To account for this need, the collection system must be modular and able to be extensible to multiple platforms or products. Moreover, by capturing Clickstream data, data which tracks a user's path through a website, we can address user concerns more directly. This would improve customer satisfaction and enhance user engagement with the platform while also providing better feedback data to the teams who will make improvements with it.

The primary goal of this project is to create a robust and extensible system that will allow enterprises, such as Capital One, to efficiently gather feature-specific user feedback across multiple platforms. This solution will not only offer seamless integration across multiple platforms but also provide Clickstream analytics to provide deeper insights to user behavior and

feedback. By drawing conclusions from the Clickstream data in real-time we can help improve the user experience. Additionally, the system should provide an administration dashboard to assist in customizing and deploying the system. Ultimately, this solution will empower Capital One to make more informed decisions, continuously improve their systems, and maintain an edge over their competitors.

Section B. Engineering Design Requirements

This section defines the project's goals, objectives, and constraints to ensure the design meets Capital One's needs. It covers key aspects such as usability, integration, security, and performance. The requirements provide a framework for delivering a scalable, accessible feedback system aligned with industry standards and internal policies. These will guide development and be revisited as needed to stay on track with project goals.

B.1 Project Goals (i.e. Client Needs)

Here are the overall goals of the project. These points represent a generic overview of what our sponsor needs from us. These points will also help us stay on track for when we work on the project.

- Improve upon Capital One's current methods of handling agent feedback
- Provide a convenient and easy-to-use web service for Capital One agents to provide feature specific feedback
- Create a database to track and monitor feedback
- Ensure that feedback modules are easily implemented

B.2 Design Objectives

Here are the design objectives of our project. The objectives of our design are inspired by the SMART (Specific, Measurable, Achievable, Realistic, and Time-bound) acronym, used for setting organized goals for projects. Each objective is linked to a design specification in the design process.

- The design will allow Capital One agents to give feature specific feedback through a web component UI module. The agent will have the option of choosing a "thumbs up"or "thumbs down" option to capture basic sentiment. In later design iterations, the agent will be able to leave comments in a textbox upon choosing the "thumbs down"option.
- The design will record agent feedback in a database which will keep track of data like agent ID, whether "thumbs up"or "thumbs down" was selected, and the text feedback given.
- The design will be generalized to allow it to be implemented in a variety of areas.

- The design will be iterative to ensure that core components of the design are met before the implementation of additional, non-vital features. This will also allow us to have a previous design on hand in the case time does not allow us to complete the current iteration of the design.

B.3 Design Specifications and Constraints

This section outlines measurable requirements and boundaries that the design must adhere to, ensuring it aligns with project goals, usability expectations, and technical feasibility. Specifications are quantitative where possible, ensuring objective validation of success. Quantitative specifications are subjective and have potential to be adjusted in the future.

1. Integration Constraints
    - Requirement: The system must integrate with Capital One's Empath system.
    - Justification: Ensures compatibility with existing infrastructure and smooth deployment.
    - Testable Metric: Successful API calls from the feedback system to the Empath platform.
    - Language Constraints: The system backend must be built using a MySQL-compatible database.
    - Testable Metric: Database must store feedback records without errors, with retrieval times under 100ms for queries involving 1,000+ records.
2. Generalization and Extensibility
    - Requirement: Design must be generalizable for use in multiple environments.
    - Testable Metric: Deploy the web component in at least two different Capital One systems.
    - Extensibility Constraint: Future iterations should allow easy updates such as adding new feedback modules or expanding to mobile platforms.
3. UI and Usability Constraints
    - UI Simplicity: Provide a thumbs up / thumbs down mechanism to keep the interface simple and increase response rates.
    - Testable Metric: Achieve a minimum 10% increase in response rate compared to existing survey systems within 3 months.
    - Accessibility: Ensure compliance with WCAG 2.1 accessibility standards.
    - Testable Metric: Test the module with screen readers and keyboard navigation tools. 100% of core functionality must remain accessible.
4. Clickstream and Data Analytics Constraints

- Requirement: Include Clickstream tracking to understand user behavior and provide actionable insights.
- Testable Metric: Collect at least 20 behavioral metrics (e.g., time spent per feature, navigation path) and visualize them in a dashboard.
- Privacy Constraints: Must filter sensitive information in compliance with PCI standards.
- Testable Metric: No PCI data (credit card details, personal info) should be present in Clickstream logs upon inspection.

5. Performance and Load Handling
    - Requirement: The system must handle at least 10,000 concurrent users without performance degradation.
    - Testable Metric: Response times should remain below 1 second for all feedback submissions under peak load.
6. Security and Legal Constraints
    - Compliance Requirements: Adhere to NIST security guidelines and Capital One internal policies for data protection.
    - Testable Metric: Conduct penetration testing, with zero critical vulnerabilities allowed before deployment.

B.4 Codes and Standards

This section identifies relevant industry standards, regulations, and codes that govern the design, development, and implementation of the project. Ensuring compliance with these standards guarantees quality, security, and interoperability of the feedback system within Capital One's infrastructure.

1. Data Security Standards
    - NIST SP 800-53 – Security and Privacy Controls for Federal Information Systems
      Applicability: The system must follow guidelines for encryption, authentication, and data privacy, ensuring feedback data and Clickstream logs are protected during storage and transmission.
      Compliance Requirement: Use HTTPS encryption for all transmissions, with AES-256 encryption for stored data.
    - PCI DSS 4.0 – Payment Card Industry Data Security Standard
      Applicability: Since user interactions may involve personal information that must not leak into Clickstream data, the system must filter and flag sensitive input.

Compliance Requirement: Validate that no PCI-relevant data (like payment card numbers) is retained in feedback logs.

2. Accessibility Standards
    - WCAG 2.1 (Web Content Accessibility Guidelines)
      Applicability: Ensures the web interface is accessible to all users, including those with disabilities.
      Compliance Requirement: The UI must pass Level AA compliance, ensuring keyboard navigation support and compatibility with screen readers.
3. Usability and UI Standards
    - W3C HTML5 and CSS3 Standards – Web Standards by the World Wide Web Consortium
      Applicability: Ensure that the feedback modules follow recognized HTML and CSS standards for cross-browser compatibility and scalability.
      Compliance Requirement: Test the system in multiple browsers (e.g., Chrome, Firefox, Safari) to ensure consistent performance.
    - ISO 9241-11:2018 – Usability: Definitions and Concepts
      Applicability: This standard guides the usability goals of the feedback system, focusing on user effectiveness, efficiency, and satisfaction.
      Compliance Requirement: Achieve above 80% user satisfaction during initial usability testing.
4. Software Development Standards
    - IEEE 830-1998 – Recommended Practice for Software Requirements Specifications
      Applicability: Use this standard to create comprehensive and clear documentation for system requirements and iterations.
      Compliance Requirement: All requirement documents must follow IEEE guidelines and be signed off by the sponsor and stakeholders.
5. Interoperability Standards
    - IRTF RFC 2616 – HTTP/1.1 Protocol
      Applicability: The system must handle HTTP requests and responses efficiently to exchange data between the frontend modules and backend services.
      Compliance Requirement: Ensure 100% compliance with HTTP standards to avoid issues during API communication.
    - ANSI SQL Standard – Database Query Language
      Applicability: The feedback database uses MySQL, which follows the ANSI SQL standard.
      Compliance Requirement: Queries must be optimized and adhere to ANSI SQL standards to ensure efficient data retrieval.

6. Capital One Internal Standards and Policies
    - Capital One API Guidelines
      Applicability: Since the system will integrate with Capital One's Empath system and cloud infrastructure, the design must adhere to internal API usage policies.
      Compliance Requirement: Successful integration tests with zero policy violations.

Section C. Scope of Work

The Modular Feedback project for Capital One aims to create a robust and extensible system for gathering feature-specific user feedback across multiple platforms. This section outlines the project's boundaries, key objectives, timeline, milestones, and deliverables.

C.1 Deliverables

Here are the list of project deliverables for our sponsor and our college. Academic deliverables are the only requirements needed for the Fall semester. By the spring semester, two iterations of our project are required by our sponsor along with additional academic deliverables.

- Fall semester deliverables:
    - Team contract
    - Project proposal
    - Preliminary design report
    - Fall poster and presentation
- Spring semester deliverables:
    - Project iteration 1
        - Web component UI module (potentially to be created in Gravity) that can be used in a plug-and-play fashion
        - “Thumbs up” and “thumbs down” option.
        - Flexible Clickstream implementation
        - Basic dashboard to display results
    - Project iteration 2
        - Allow users to input their concerns into a textbox for the “thumbs down” scenario and determine a storage solution for these inputs.
        - PCI data filter implementation.
        - Create admin feedback UI to view feature specific verbatims and possible enhancements
    - Final design report
    - Capstone EXPO poster and presentation

C.2 Milestones

Milestone	Estimated Time	Completion Date
Requirements gathering and analysis	2 weeks	October 25, 2024
System architecture design	3 weeks	November 15, 2024
UI module development (Iteration 1)	4 weeks	December 13, 2024
Clickstream implementation	3 weeks	January 10, 2025
Basic dashboard development	2 weeks	January 24, 2025
Iteration 1 testing and refinement	2 weeks	February 7, 2025
Textbox and storage implementation (Iteration 2)	3 weeks	February 28, 2025
PCI data filter development	2 weeks	March 13, 2025
Admin feedback UI development	3 weeks	April 3, 2025
Iteration 2 testing and refinement	2 weeks	April 17, 2025
Final documentation and presentation preparation	3 weeks	May 8, 2025

C.3 Resources

The following resources will be needed for project completion:

1. Hardware:
    - Development laptops/workstations
    - Test servers for deployment

2. Software:
    - Integrated Development Environment (IDE) compatible with chosen programming languages
    - Version control system (e.g., Git)

- Database management system (e.g., MySQL)

3. Cloud Services:
    - Access to Capital One's cloud infrastructure for deployment and testing

4. APIs and Libraries:
    - Gravity framework (if used for UI module development)
    - Clickstream analytics libraries
    - Data visualization libraries for dashboard development

5. Data:
    - Sample datasets for testing feedback collection and analysis
    - PCI-compliant test data for filter development

6. Documentation:
    - Capital One's internal API documentation
    - Relevant coding standards and style guides

7. Access:
    - Necessary permissions to integrate with Capital One's Empath system

Our team will work closely with the project sponsor and faculty advisor to ensure all the required resources are available and that the project remains within scope throughout its duration.

Section D. Concept Generation

After analyzing the requirements and constraints of our project, we determined that implementing a dashboard-centric feedback system is the most viable approach. An admin dashboard provides a centralized, scalable, and actionable way to analyze feedback trends and user behaviour. Below are three design concepts that outline potential dashboard implementations, each tailored to address the project's objectives:

1. Minimalistic Feedback Dashboard
    - Description: A lightweight dashboard that consolidates feature-specific feedback data in real time. This design focuses on simplicity and usability, enabling administrators to quickly view and analyze feedback trends without relying on additional modules or widgets.
    - Features:
        - Visual representation of thumbs up and down data across features.
        - Simple feedback submission mechanism integrated within existing systems.
    - Pros and Cons:
        - The minimalistic option allows easy implementation and should offer an overview of user sentiment across multiple features. It has low development and resource requirements as well.
        - This may however provide limited in-depth feedback analysis and may require manual intervention for deeper insights on user feedback.

2. Enhanced Feedback Dashboard
    - Description: A more sophisticated version of the feedback dashboard that incorporates Clickstream data and detailed feedback collection mechanisms. This design allows for richer insights into user behavior and sentiment.
    - Features:
        - Advanced data visualization, this includes Clickstream analytics to track user navigation and engagement.
        - Modular design to accommodate additional analytic tools in future iterations.
    - Pros and Cons:
        - The enhanced version of the feedback dashboard would provide actionable insights for feature specific improvements on products.
        - It would also enhance the understanding of user behavior and problem points.
        - The enhancements may raise development costs and complexity on top of requiring a robust infrastructure to handle large data volumes.

3. Comprehensive Feedback Dashboard

- Description: A centralized platform providing enterprise-wide analytics. This design consolidates user feedback, Clickstream data, and advanced reporting tools for a high-level view of use sentiment and behavior.
- Features:
    - The dashboard should be fully customizable with detailed filters for specific feedback types.
    - Potential integration with machine learning tools for predictive analytics.
    - Real-time alerts for users with critical issues and agent support.
- Pros and Cons:
    - Higher level insights provide a better opportunity for strategic decision making with the data.
    - Scalable across multiple platforms for higher user engagement and more realistic data.
    - The comprehensiveness of this dashboard will require higher initial costs and resource requirements.
    - The complexity of this dashboard may overwhelm users unfamiliar with the tool

Section E. Concept Evaluation and Selection

We developed a systematic decision making process for evaluating which of the three designs would be the best fit. This process involved developing selection criteria, assigning weight factors, and applying metrics to rank the concepts.

1. Selection Criteria:
    - Performance: Ability to handle high user loads without sacrificing system quality
    - Cost: Estimated development and maintenance expenses.
    - Scalability: Adaptability for new platforms or features.
    - Usability: Simplicity and accessibility for users and administrators.
    - Feedback Depth: Quality and actionability of gathered feedback.
2. Weighting Factors
    - The weighting of criteria was based upon project specifications:
    - Performance: 25%
    - Cost: 10%
    - Scalability: 30%
    - Usability: 20%
    - Feedback Depth: 15%
3. Decision Matrix

Criteria	Weight	Minimalistic Dashboard Score	Enhanced Dashboard Score	Comprehensive Dashboard Score
Performance	25%	8	9	7
Cost	10%	9	7	6
Scalability	30%	7	9	9
Usability	20%	8	9	7
Feedback Depth	15%	6	9	9
Weighted Total	100%	7.8	8.8	7.8

Based on the weighted scores, the Enhanced Feedback Dashboard emerged as the most viable option. Its advanced data visualization and modular design offer the best balance between

scalability, usability, and feedback depth. Although it has higher development costs, its potential to deliver actionable insights outweighs the initial investment and additional development time needed. The selected design concept will be further refined and validated through detailed prototyping and client feedback. Additional features, such as PCI data collection will be explored in subsequent project phases.

Section F. Design Methodology

F.1 Computational Methods

- The main data that we want to track is consumer feedback on products and services to allow CapitalOne to make changes accordingly.
- Our main method of tracking data is through a basic rating system, but we're also tracking clickstream data.
- Tracking clickstream data allows us to track a user's pathing throughout a website.
- This data would be beneficial in enhancing user engagement and satisfaction.

F.2 Experimental Methods

- The design will be iterative to ensure that core components of the design are met before the implementation of additional, non-vital features.
- This will also allow us to have a previous design on hand in the case time does not allow us to complete the current iteration of the design.

F.3 Architecture/High-level Design

- The design will allow Capital One agents to give feature specific feedback through a web component UI module.
- The agent will have the option of choosing a "thumbs up"or "thumbs down" option to capture basic sentiment.
- In later design iterations, the agent will be able to leave comments in a textbox upon choosing the "thumbs down"option.

F.4 Validation Procedure

- The most important aspect to validate completion of this project is for the module to integrate with Capital One's empath system.
- The simplest method of doing this is to create the feedback module using a database that is compatible with MySQL.
- The module should also be generalized to allow it to function in different areas and iterable to allow further work on the module.

Section G. Results and Design Details

G.1 Modeling Results

- Since the system will integrate with Capital One's Empath system and cloud infrastructure, the design must adhere to internal API usage policies.
- Queries must be optimized and adhere to ANSI SQL standards to ensure efficient data retrieval.
- Provide a thumbs up / thumbs down mechanism to keep the interface simple and increase response rates.

G.2 Prototyping and Testing Results

- Created original prototype in PHP
    - Design was well received, but we were told that PHP wouldn't be compatible with the Empath system, so we recreated the code in SQL.
- Sample data used to test the feedback system
    - The numbers correspond to different ratings with the option of leaving comments
    - We must also filter sensitive information to align with privacy goals

```
-- Insert sample data into the 'feedback' table

INSERT INTO feedback (agent_id, feature_id, overall_rating, ease_of_use, flexibility, reliability, comment) VALUES

(1, 1, 9.5, 9.0, 8.0, 9.0, 'Great online banking experience!'),

(2, 1, 7.0, 6.5, 7.0, 6.0, 'Easy to use, but could use some improvements'),

(3, 2, 9.5, 9.0, 8.5, 9.0, 'The mobile app is fantastic!'),

(1, 2, 6.0, 5.5, 7.0, 6.0, 'App is okay, but crashes sometimes'),

(2, 3, 8.5, 8.0, 9.0, 8.5, 'Love the rewards program'),

(3, 3, 9.5, 9.0, 9.5, 9.0, 'Best rewards in the industry'),

(1, 4, 4.5, 4.0, 5.0, 4.5, 'Long wait times for customer support'),

(2, 4, 7.5, 7.0, 7.5, 7.0, 'Support team was very helpful'),

(3, 5, 6.5, 6.0, 6.5, 7.0, 'Loan application process is average'),
```

```
(1, 5, 9.0, 8.5, 9.0, 9.0, 'Quick and easy loan application');
```

G.3 Final Design Details/Specifications

- Database must store feedback records without errors, with retrieval times under 100ms for queries involving 1,000+ records.
- Deploy the web component in at least two different Capital One systems.
- Achieve a minimum 10% increase in response rate compared to existing survey systems within 3 months.
- Test the module with screen readers and keyboard navigation tools. 100% of core functionality must remain accessible.
- Collect at least 20 behavioral metrics (e.g., time spent per feature, navigation path) and visualize them in a dashboard.
- Response times should remain below 1 second for all feedback submissions under peak load.
- Conduct penetration testing, with zero critical vulnerabilities allowed before deployment.

Section H. Societal Impacts of Design

H.1 Public Health, Safety, and Welfare

The Modular Feedback system's primary safety considerations revolve around data security and user privacy. Key safety features include:

- Implementation of PCI data filtering to prevent collection of sensitive personal/financial information
- HTTPS encryption for all data transmission
- AES-256 encryption for stored data
- Compliance with WCAG 2.1 accessibility standards to ensure all users can access and use the system
- Stress testing to prevent system failures that could impact Capital One's services

H.2 Societal Impacts

The system will influence how users interact with financial services by:

- Creating more direct communication channels between users and service providers
- Empowering users to influence product development and improvements
- Potentially reducing frustration by providing immediate feedback options
- Helping build trust through transparent feedback mechanisms

H.3 Political/Regulatory Impacts

The system must operate within several regulatory frameworks:

- Compliance with banking regulations regarding customer data
- Adherence to privacy laws and data protection standards
- Potential influence on future financial service regulations regarding customer feedback
- Setting precedents for feedback collection in the financial industry

H.4 Economic Impacts

The project offers several economic benefits:

- Reduced costs compared to traditional survey methods
- Improved product development efficiency through targeted feedback
- Potential increase in customer retention through better service
- More efficient allocation of development resources based on user needs

H.5 Environmental Impacts

The digital feedback system provides environmental benefits:

- Reduction in paper usage compared to traditional feedback methods
- Energy-efficient cloud-based infrastructure
- Minimal physical infrastructure requirements
- Lower carbon footprint compared to in-person feedback collection

H.6 Global Impacts

The system's global implications include:

- Setting standards for digital feedback collection in financial services
- Potential application across international markets
- Influencing global banking customer service practices
- Contributing to worldwide financial technology innovation

H.7 Ethical Considerations

Key ethical aspects include:

- Ensuring user privacy and data protection
- Providing equal access across all user demographics
- Transparent handling of user feedback
- Fair representation of all user groups in feedback collection
- Avoiding manipulation of feedback data

Section I. Cost Analysis

We have yet to acquire any expenses, but in the case we do in the future, they will be recorded here. To make sure we are as cost efficient as possible, we have implemented some cost-saving strategies.

Cost-Saving Strategies:

- Utilizing free student developer licenses where possible
- Making use of open-source tools and frameworks
- Leveraging VCU's existing development resources
- Using Capital One's internal development infrastructure where available
- Taking advantage of student/academic discounts
- Using free tiers of cloud services

Section J. Conclusions and Recommendations

The Modular Feedback project exemplifies the power of iterative design and collaboration in addressing complex challenges in user feedback collection. From its inception, the project was guided by a clear vision to enhance Capital One's ability to gather feature-specific feedback efficiently and effectively. The team leveraged the engineering design process to evolve the initial concept into a robust and scalable system that integrates seamlessly into existing infrastructure.

Through careful planning, the team will successfully tackle significant obstacles, such as ensuring compliance with Capital One's internal API standards, integrating with the Empath system, and adhering to stringent security and accessibility requirements. The shift from an initial PHP-based prototype to a MySQL-compatible solution underscores the team's adaptability and commitment to meeting project goals. Each design iteration brought valuable insights, leading to enhanced functionality, improved usability, and greater scalability.

Key accomplishments will include the development of a modular web component for sentiment-based feedback, Clickstream integration for deeper behavioral analytics, and a user-friendly admin dashboard for data visualization. The system should demonstrate strong performance under load, compatibility with WCAG 2.1 standards, and adherence to PCI and NIST data protection guidelines.

The project paves the way for several future advancements. Introducing machine learning capabilities to analyze trends in feedback and automating feedback categorization could provide even deeper insights. Additionally, expanding the system to include mobile platform compatibility and multi-language support would extend its applicability across diverse user groups. Enhanced features such as adaptive feedback prompts and predictive analytics could further optimize the feedback process.

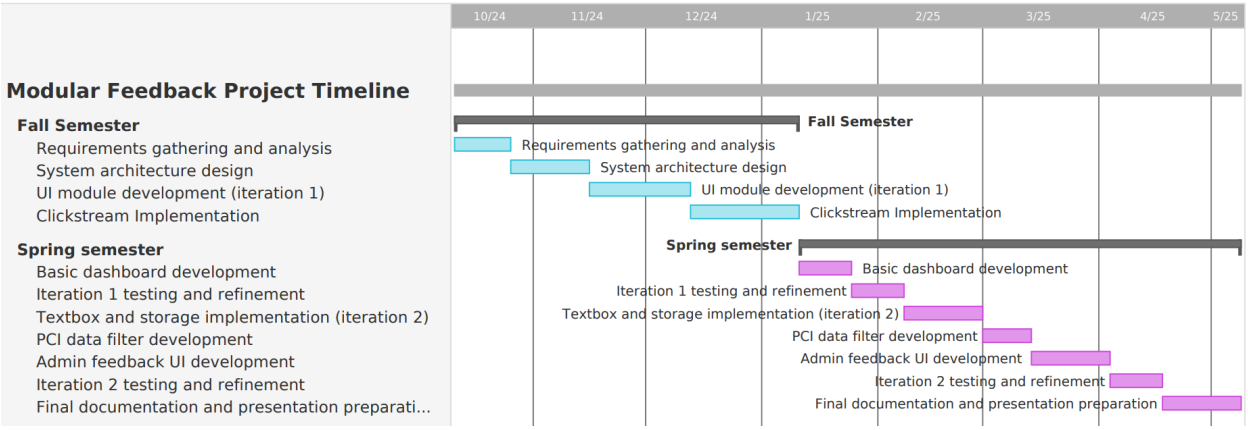
Unanswered questions include exploring how this system could be adapted for other industries beyond financial services and assessing the long-term impact on user engagement and satisfaction. These areas offer exciting opportunities for future research and development.

Major milestones, including requirements analysis, initial prototyping, and system validation, will establish a strong foundation for continued work. Future teams could build upon this by refining the admin dashboard, exploring advanced analytics, or integrating real-time notifications for feedback trends.

The Modular Feedback system will represent a significant step forward in enhancing user experience and product development through targeted feedback. Its scalable, secure, and user-centric design will position it as a valuable tool for Capital One, with the potential for broader applications across industries.

Appendix 1: Project Timeline

Below is a Gantt chart for how we plan to make progress on the project.



Appendix 2: Team Contract (i.e. Team Organization)

Step 1: Get to Know One Another. Gather Basic Information.

Task: This initial time together is important to form a strong team dynamic and get to know each other more as people outside of class time. Consider ways to develop positive working relationships with others, while remaining open and personal. Learn each other's strengths and discuss good/bad team experiences. This is also a good opportunity to start to better understand each other's communication and working styles.

Team Member Name	***Strengths each member bring to the group***	***Other Info***	***Contact Info***
Ahmed Salih	*Object-Oriented programming, SQL, Scrum Methodology*	*I'm good at learning things so I can fill roles.*	salihas@vcu.edu
Owen Cupps	*Strengths in Java and C, mathematics, problem solving*	*I like working in teams and I'm a friendly guy. I enjoy learning new things and overcoming challenges.*	cuppsos@vcu.edu
Ethan Scott	*Programming in Java and C, great communicator*	*well-rounded and a good team worker*	scottea3@vcu.edu
Bao Do(Will)	*Web development, css, php, react. Fluent in SQL Queries and databases*	*always eager to face new experiences and challenges*	dob2@vcu.edu

Other Stakeholders	***Notes***	***Contact Info***
Hong-Sheng Zhou	*Faculty Advisor*	hszhou@vcu.edu
Mahesh Nair	*Sponsor*	mahesh.bahulleyannair@capitalone.com

Jonathon Headley	*Assisting Sponsor*	jonathon.headley@capitalone.com

Step 2: Team Culture. Clarify the Group's Purpose and Culture Goals.

Task: Discuss how each team member wants to be treated to encourage them to make valuable contributions to the group and how each team member would like to feel recognized for their efforts. Discuss how the team will foster an environment where each team member feels they are accountable for their actions and the way they contribute to the project. These are your Culture Goals (left column). How do the students demonstrate these culture goals? These are your Actions (middle column). Finally, how do students deviate from the team's culture goals? What are ways that other team members can notice when that culture goal is no longer being honored in team dynamics? These are your Warning Signs (right column).

Resources: More information and an example Team Culture can be found in the Biodesign Student Guide "Intentional Teamwork" page (webpage | PDF)

Culture Goals	***Actions***	***Warning Signs***
Meeting in person at least once per week	- *Text group the day of meetings with topics of discussion* - *Inform each other of our availabilities prior to meeting*	- *Student misses first meeting, warning is granted* - *Student misses meetings afterwards – issue is brought up with faculty advisor*
Informing the group of any delays in completing assignments	- *Stay up to date with each other's project responsibilities* - *Set reasonable deadlines and note when an extension is needed*	- *Student shows up for weekly meeting with no considerable work done*
Respectful and Open Communication	- *Actively listen to others without interrupting.* - *Use constructive language when giving feedback, focusing on the work, not the individual.*	- *Team members interrupt others or dismiss ideas without consideration.* - *Conversations become personal or confrontational rather than focused on the project.*

	- *Be mindful of different perspectives and resolve disagreements professionally.*	- *One or more members become quiet or withdrawn during discussions.*

Step 3: Time Commitments, Meeting Structure, and Communication

Task: Discuss the anticipated time commitments for the group project. Consider the following questions (don't answer these questions in the box below):

- What are reasonable time commitments for everyone to invest in this project?
- What other activities and commitments do group members have in their lives?
- How will we communicate with each other?
- When will we meet as a team? Where will we meet? How Often?
- Who will run the meetings? Will there be an assigned team leader or scribe? Does that position rotate or will same person take on that role for the duration of the project?

Required: How often you will meet with your faculty advisor advisor, where you will meet, and how the meetings will be conducted. Who arranges these meetings?
See examples below.

Meeting Participants	***Frequency*** ***Dates and Times / Locations***	***Meeting Goals*** ***Responsible Party***
Students Only	*As Needed, On Discord Voice Channel or Zoom*	*Update group on day-to-day challenges and accomplishments (Ahmed will record these for the weekly progress reports and meetings with advisor)*
Students Only	*Every Tuesday and/or Thursday at least an hour before our allotted class time, in the Computer Lab of Engineering West Hall*	*Actively work on project (Ahmed will document these meetings by taking photos of whiteboards, physical prototypes, etc, then post on Discord and update Capstone Report)*
Students + Faculty advisor	*As Needed, via Zoom*	*Update faculty advisor and get answers to our questions (Ahmed will scribe; Ethan will create meeting agenda and lead meeting)*

Students + Project Sponsor	*As Needed, via Zoom*	*Update project sponsor and make sure we are on the right track (Ahmed will scribe; Ethan will create meeting agenda and lead meeting; Owen will present prototype so far)*

Step 4: Determine Individual Roles and Responsibilities

Task: As part of the Capstone Team experience, each member will take on a leadership role, ***in addition to*** contributing to the overall weekly action items for the project. Some common leadership roles for Capstone projects are listed below. Other roles may be assigned with approval of your faculty advisor as deemed fit for the project. For the entirety of the project, you should communicate progress to your advisor specifically with regard to your role.

- **Before meeting with your team**, take some time to ask yourself: what is my "natural" role in this group (strengths)? How can I use this experience to help me grow and develop more?
- **As a group,** discuss the various tasks needed for the project and role preferences. Then assign roles in the table on the next page. Try to create a team dynamic that is fair and equitable, while promoting the strengths of each member.

Communication Leaders

Suggested: Assign a team member to be the primary contact for the client/sponsor. This person will schedule meetings, send updates, and ensure deliverables are met.

Suggested: Assign a team member to be the primary contact for faculty advisor. This person will schedule meetings, send updates, and ensure deliverables are met.

Common Leadership Roles for Capstone

1. **Project Manager:** Manages all tasks; develops overall schedule for project; writes agendas and runs meetings; reviews and monitors individual action items; creates an environment where team members are respected, take risks and feel safe expressing their ideas.
   Required: On Edusourced, under the Team tab, make sure that this student is assigned the Project Manager role. This is required so that Capstone program staff can easily identify a single contact person, especially for items like Purchasing and Receiving project supplies.
2. **Logistics Manager:** coordinates all internal and external interactions; lead in establishing contact within and outside of organization, following up on communication of commitments, obtaining information for the team; documents meeting minutes; manages facility and resource usage.
3. **Financial Manager:** researches/benchmarks technical purchases and acquisitions; conducts pricing analysis and budget justifications on proposed purchases; carries out team purchase requests; monitors team budget.

4. **Systems Engineer:** analyzes Client initial design specification and leads establishment of product specifications; monitors, coordinates and manages integration of sub-systems in the prototype; develops and recommends system architecture and manages product interfaces.
5. **Test Engineer:** oversees experimental design, test plan, procedures and data analysis; acquires data acquisition equipment and any necessary software; establishes test protocols and schedules; oversees statistical analysis of results; leads presentation of experimental finding and resulting recommendations.
6. **Manufacturing Engineer:** coordinates all fabrication required to meet final prototype requirements; oversees that all engineering drawings meet the requirements of machine shop or vendor; reviews designs to ensure design for manufacturing; determines realistic timing for fabrication and quality; develops schedule for all manufacturing.

Team Member	***Role(s)***	***Responsibilities***	***Reason***
Ethan Scott	*Project Manager*	✔ *Manage overall project schedule, run meetings, and ensure team members are on track.* ✔ *Manage risk, ensuring potential project roadblocks are addressed early.*	*Great communicator and well-rounded. His ability to collaborate and work effectively with the team can help ensure smooth coordination of tasks and goals.*
Ahmed Salih	*Logistic Manager*	✔ *Coordinate meetings, manage internal and external communications, and document meetings.* ✔ *Managing resources, such as room bookings or equipment.*	*Has experience in Scrum methodology, which makes him suitable for organizing tasks and ensuring communication within and outside the team.*
Owen Cupps	*System Engineer*	✔ *Define system specifications, monitor integration, and manage system architecture.*	*Strengths in mathematics, problem-solving, and proficiency in Java and C make him a good fit for analyzing design specifications and leading system integration.*
Bao Do	*Financial Manager*	✔ *Handle pricing analysis, budget tracking, and team purchases* ✔ *Tracking project milestones related to financial needs, ensuring purchases align with the budget.*	*Strong skills in web development and databases. His experience with data structures and attention to detail makes him a great fit for managing the budget and technical purchases.*

Step 5: Agree to the above team contract

Team Member: Bao Do	*Signature: Bao*
Team Member: Owen Cupps	*Signature: Owen Cupps*
Team Member: Ahmed Salih	*Signature: Ahmed Salih*
Team Member: Ethan Scott	*Signature: Ethan Scott*

References

Provide a numbered list of all references in order of appearance using APA citation format. The reference page should begin on a new page as shown here.

[1] Capital One. (2024) *About*. https://www.capitalone.com/. Retrieved October 11, 2024. www.capitalone.com/about/.

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