VCU College of Engineering

CS 25-331: AI-based browser extension for knowledge management using retrieval-augmented generation and large language models

Project Proposal

Prepared for

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Date

10/6/2024

Executive Summary

The executive summary highlights the key points of the document. While your advisor(s) and sponsor are expected to read the document in detail, others may only read the summary looking for a brief overview of the report. Casual readers may look at the summary to decide if they would like to continue reading. Some, more senior decision makers (e.g. executives), may read the summary to help make decisions regarding the future of the project (e.g. continuation, financing, resource allocation, etc.). It is important that all readers get a complete sense of the project, including purpose, primary objectives, design requirements, deliverables, work done to date, and timeline, among other required components provided in a table of contents. Summaries should be considered as "stand-alone" containing a complete account of the essential points of the document in chronological order of the document. Particular focus should be placed on the first sentence in order to draw readers in and should explicitly include the "who, what, and why" of the project. The executive summary is usually between half a page and a full page.

Note: The Executive Summary should be updated between major reports as more knowledge is acquired and understanding of the project expands. For example, when submitting Preliminary Design Report in December 2024, make sure you update this page to reflect the progress on the project since the submission of Project Proposal in early October 2024.

Table of Contents

Section A. Problem Statement

Professionals, researchers, and students who work with vast amounts of digital information are facing the problem. The need for efficient knowledge retrieval in data-heavy environments is crucial. Current tools lack context-awareness and provide overwhelming, unorganized results, leading to inefficiency and frustration.

The problem is highly prevalent across many industries, particularly those dealing with research, education, law, and technology. As digital information continues to grow exponentially, the issue of managing and retrieving useful knowledge affects millions of people daily.

The costs include decreased productivity due to time wasted on inefficient searches, mental fatigue, and stress. Economically, organizations face increased operational costs due to poor information management. On a societal level, this can lead to burnout and reduced job satisfaction. Additionally, energy consumption from excessive data processing has environmental implications.

This project falls under artificial intelligence (AI) and knowledge management. It aims to improve how individuals retrieve, organize, and manage information using retrieval-augmented generation and large language models. The AI field is rapidly evolving, with a focus on enhancing productivity and decision-making through smarter information processing.

The project leverages cutting-edge technology like LLMs to offer personalized, context-aware knowledge retrieval, which is a significant improvement over traditional search engines or manual data management systems. By combining retrieval and generation techniques, it not only enhances accuracy but also tailors the information to users' specific needs in real time, reducing the inefficiency of current methods.

Yes, similar problems have been tackled by search engines and enterprise knowledge management tools. However, these systems often deliver broad, unspecific results that require further filtering. This project builds on those solutions by offering a more intelligent and contextually aware system using AI-driven models, improving the relevance and usefulness of retrieved information. Existing solutions lack the deep integration of retrieval and generation, which this project provides, offering both faster and more accurate outputs tailored to users' specific needs.

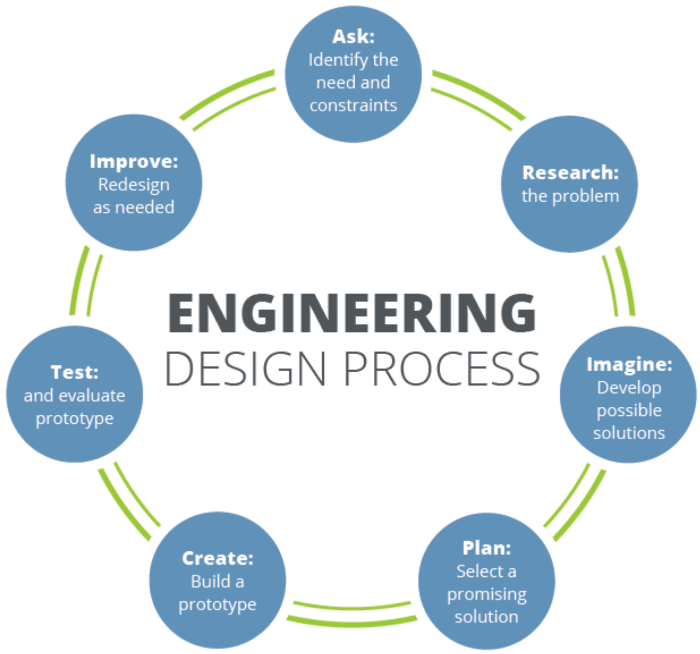

Figure 1. The iterative nature of the engineering design process [2].

Section B. Engineering Design Requirements

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

The project goals describe the target benefits the project will produce from the perspective of the client. Goals do not describe what the design will do, only the intended outcome of said design.

- Decrease the time spent fetching the location of information from sources.
- Create a convenient, centralized location for saving sources.

B.2 Design Objectives

Objectives describe *what the design will do*, not how it should do it. Objectives are SMART – Specific, Measurable, Achievable, Realistic, and Time-bound.

- The design will exist in the form of a browser extension.
- The design will receive and save sources from the user.
- The design will receive questions about the location of information from the user.
- The design will output the location of information queried by the user if said information is contained in a saved source.

B.3 Design Specifications and Constraints

A list of design specifications and constraints include all limitations, restrictions, and requirements of the design. They are firm limits that must be met for a design to be acceptable and are ultimately used to measure the success of a design. Each specification or constraint should map to one or more design objective(s) and explicitly state *how the design* will meet the objectives. Specifications and constraints should be specific and are often numerical. They must be measurable or testable to prove that the design has met all of the design objectives.

Constraints:

- The design must integrate with major browsers such as Chrome, Firefox, and Edge.
- The design must integrate an LLM for data processing
- The design must operate using agreed upon resources
- The design must not exceed a particular amount of memory usage on client device during operation
- The design must not interfere with other web applications
- Design must operate for at least 3 hours without requiring maintenance

- The extension must be optimized for use on a variety of hardware platforms, including low-performance devices
- Design must comply with specified regulations

B.4 Codes and Standards

List all specific codes and standards that are relevant to the design providing specific details of each as they relate to the design. While the terms codes and standards are often used interchangeably, there are in fact important differences in their definitions that should be understood. **Standards** are documents that provide a set of technical definitions, instructions, rules, guidelines and/or characteristics of a product, process, or service meant to provide consistent and comparable results (e.g. performance requirements, dimensions, testing procedures, file formats etc.). They allow for interchangeability of components and system interoperability and are typically produced by industry or professional organizations such as ASME, ANSI, ASTM, IEEE, ISO, ACM, IAPP, AIS, etc. Standards are meant to help ensure quality, reliability, and safety.

Codes are laws or regulations that specify the methods, materials, components, etc. required for use in a certain product, process, or structure. Codes have been *codified* into a formal written policy or law and can be approved at the local (municipal), state, or federal level. While standards provide sets of guidelines, codes are constraints that *must* be met in accordance with the law. It is, however, common for codes to reference or require the use of one or more standards. Some common code producers include the EPA, OSHA, DOTs, and the NFPA. Codes help set minimum acceptable levels in order to protect public health, safety, welfare.

Codes and standards are often listed by their producer followed by an identifying numerical code. They often contain hyphens or periods which may help reference specific parts of a larger code/standard or provide the year of the latest revision. Some general examples in a list of codes and standards are as follows:

- IEEE/ISO/IEC 12207 – Draft International standard - Systems and software engineering
- ISO/IEC 27001 – Information security, cybersecurity and privacy protection
- California Consumer Privacy Act (CCPA) – gives consumers control over the personal information that businesses collect about them
- NIST SP 800-40 r3: Provides guidance for developing and refining patching approaches

Section C. Scope of Work

The project scope defines the boundaries of the project encompassing the key objectives, timeline, milestones and deliverables. It clearly defines the responsibility of the team and the process by which the proposed work will be verified and approved. A clear scope helps to facilitate understanding of the project, reduce ambiguities and risk, and manage expectations. In addition to stating the responsibilities of the team, it should also explicitly state those tasks which fall *outside* of the team's responsibilities. *Explicit bounds* on the project timeline, available funds, and promised deliverables should be clearly stated. These boundaries help to avoid *scope creep*, or changes to the scope of the project without any control. This section also defines the project approach, the development methodology used in developing the solution, such as waterfall or agile (shall be chosen in concert with the faculty advisor and/or project sponsor). Good communication with the project sponsor and faculty advisor is the most effective way to stay within scope and make sure all objectives and deliverables are met on time and on budget.

C.1 Deliverables

These deliverables are pivotal to ensuring the project meets its objectives and provide tangible results for the project sponsor:

Prototype: A functional prototype of the browser extension, showcasing core functionalities such as retrieving knowledge from bookmarks, documents, or web sources using natural language queries.

Final Model: The fully-developed model incorporating improvements from testing and feedback on the prototype. This will include optimized retrieval algorithms, refined user interfaces, and enhanced natural language understanding capabilities.

Documentation: Comprehensive documentation for the browser extension, including system architecture, design decisions, user manuals, and technical guides for both developers and end users.

Reports and Presentations: A series of reports, including the preliminary design report, final design report, and a poster presentation for the Capstone EXPO. These will provide detailed insights into the development process, challenges encountered, and solutions implemented.

Given the complexity of integrating RAG and LLMs into a user-friendly browser extension, some deliverables may require access to specific resources and collaboration between team members working both on-site and remotely.

To address potential challenges, the team will also prepare to mitigate foreseeable obstacles such as delays in acquiring third-party components, access to required software, and ensuring that remote work is effectively managed with shared resources and communication tools. The timely completion of these deliverables will be essential to the project's success.

C.2 Milestones

The following is a list of key milestones detailing major tasks that must be completed to ensure project deliverables are met:

Team Contract Completion: Establishment of roles, responsibilities, and timelines for team members. Completed on 09/06/2024.

Project Proposal Submission: Detailed description of the project's scope, objectives, and deliverables. Due by 10/11/2024 (in progress).

Fall Design Poster: Initial design presentation for the project, summarizing the early work and vision for the extension. To be completed by 11/15/2024.

Preliminary Design Report: A comprehensive report outlining the early development, design decisions, and progress on the system prototype. Due by 12/09/2024.

Development of Core System: Initial coding and integration of retrieval-augmented generation with the browser. Date TBD, following the development phase.

Abstract for Capstone Expo: A concise abstract summarizing the project's goals, methodology, and expected results for the Capstone Expo. Due by 03/28/2025.

Poster and Presentation for Expo: Final poster and presentation materials for showcasing the project at the Capstone Expo. Due by 03/28/2025.

Final Design Report: A detailed report summarizing the project, including the final system's design, testing results, and recommendations for future work. Due by 05/02/2025.

Each of these milestones is critical for tracking project progress and ensuring that the team stays on schedule with respect to the project's overall goals. The timeline will be revisited periodically to accommodate changes as the project evolves.

C.3 Resources

The successful completion of this AI-based browser extension project will require several key resources, both in terms of hardware and software. These resources will be crucial in ensuring that the prototype and final model are developed, tested, and refined efficiently. Some examples of the necessary resources include:

Departmental GPU Servers: Access to high-performance GPU servers is essential for training and fine-tuning the large language models used in the extension, especially when working with complex retrieval-augmented generation techniques.

APIs for Large Models: Leveraging external APIs for large pre-trained language models will allow the extension to utilize state-of-the-art natural language processing capabilities, accelerating development by reducing the need for building models from scratch.

Datasets: A variety of datasets will be needed for training, testing, and evaluating the retrieval algorithms, including both general and domain-specific knowledge sources. Access to clean, diverse, and representative data will be key to ensuring model accuracy and relevance.

Cloud Computing Services: To scale the project effectively, cloud computing resources may be needed, particularly for tasks that require parallel processing or large-scale data storage and retrieval.

Software Tools: This includes integrated development environments (IDEs), machine learning libraries (e.g., TensorFlow, PyTorch), and version control systems (e.g., Git) to facilitate collaborative development and ensure smooth project management.

Section D. Concept Generation

A number of methods can be used to help generate design concepts from simple reflection and brainstorming, to working the problem backwards, using reverse thinking techniques, and looking to nature for inspiration (i.e. biomimicry). Existing solutions, or components of existing solutions, can be substituted, combined, adapted, modified, put to other uses, eliminated, or rearranged to meet new design objectives and specifications. A minimum of 3 overall design concepts is required for this section although more are welcome. Provide a brief description of how each design concept addresses the design problem. Discuss the potential pros and cons, including and potential risks of failure, of each of these concepts.

It is likely that each design concept may consist of several components. In this case, one or more of these components may offer a sub-problem that can be further explored, modified, or otherwise improved upon. These sub-problems may lead to the addition of several additional design concepts and may require the inclusion of a design concept chart or matrix to organize all ideas and potential solutions.

Provide any initial design sketches, drawings, 3D renderings, or conceptual models such as dataflow diagrams, process flows, etc. developed during the concept ideation phase. All hand drawings should be drawn to scale using basic engineering drafting tools (i.e. ruler, protractor, and compass). Geometric stencils can also be used to help produce quality hand drawings. Drawings should be presented in a profession manner, preferably done on engineering graph paper and using a high-quality scan. All sketches should be labeled to identify major components and different drawing views or projections if applicable. Basic dimensions should be provided to give a general sense of scale. Label each sketch or drawing with the name of the team member responsible for the sketch, the date it was drawn, and the drawing scale.

Section E. Concept Evaluation and Selection

Using a systematic decision-making process, evaluate each of the design concepts and choose the one that is most likely to succeed in meeting the design objectives and constraints. A Decision Matrix, or Pugh Matrix, helps to analyze alternatives, eliminate biases, and make rational decisions through thought and structure. First, work to develop a set of selection criteria for which to evaluate the previously generated design concepts. Selection criteria often include concepts of performance, cost, safety, reliability, risk, etc. Note that the selection criteria developed here will likely be more general than the project design objectives. As with the design objectives, conversations with the client help define appropriate selection criteria.

In many cases, the client may value the selection criteria differently, preferring that more emphasis be placed on some than others. In this case, weighting factors may be used to place more or less importance on the various criteria in the decision making process. Again, conversations with the client can be used to define criteria weighting factors. Often times, these conversations must be analyzed and interpreted by the team to determine which criteria are more important to the client and by how much. Feel free to discuss the assigned weighting factors with the client to see if they seem accurate.

Next, define an associated metric to represent each criteria. Metrics should be specific and quantifiable, providing numerical values that quantify the often vague concepts of the selection criteria. Metrics can be obtained, generated, or estimated through a number of methods including simple background research, preliminary design calculations, or basic analyses. Note that these metrics do not need to specifically align with the design specifications although there may be some commonality between the two. Provide a brief discussion of the rationale for selecting each of the assigned metrics.

Using the defined metrics, evaluated each design concept against all selection criteria by filling out a Decision Matrix. Design concepts can be compared by using simple rank scoring, raw scoring, or weighted scoring techniques and design concept with which to move forward can be selected. This type of process provides a meaningful, unbiased means for choosing a preliminary design concept prior to moving forward with more comprehensive, detailed analyses as provided in the design methodology section below. The results of this process should be discussed with the project client prior to moving forward with the selected design. Table 1 provides an example of a simple decision matrix.

Table 1. Example of a Decision Matrix.

	Design Concept A	Design Concept B	Design Concept C	Design Concept D
Criteria 1				
Criteria 2				
Criteria 3				
Criteria 4				
Criteria 5				
Total Score				

Note: Weights can be assigned to each criterion if desired.

Section F. Design Methodology

Provide a detailed explanation of the methods that will be used to help evaluate, improve, and evolve the design through the iterative engineering design process. Consider that ultimately, the final design must be verified and validated to ensure that it meets all of the previously developed and listed design objectives and specifications. Verification ensures that the design meets all specification, while validation confirms that the design functions as intended such to meet the client's needs. While it is common for initial design concepts to first be evaluated using simplified design criteria and metrics, the chosen design should be advanced, and later verified, using engineering calculations, computational models, experimental data, and/or testing procedures.

Use this section to describe any underlying physical principles and mathematical equations that govern the design. Provide details of any computer-aided modeling techniques used to evaluate the design including the software used, prescribed boundary conditions, and assumptions. Include a detailed description of any experimental testing methods including required testing equipment, test set-up layout, data acquisition and instrumentation, and testing procedures. If one or more prototypes is to be produced and tested, provide a detailed description of how each will be evaluated.

Note: The contents of this section are expected to vary from project to project. Subsections may be appropriate for providing details of analytical, computational, experimental, and/or testing methods. Some potential subsections that may be included in this section are provided. While critical design equations may be provided here, lengthy mathematical derivations may be included in an appendix. Validation procedures are critical and all projects should address such topic.

F.1 Computational Methods (e.g. FEA or CFD Modeling, example sub-section)

F.2 Experimental Methods (example subsection)

F.3 Architecture/High-level Design (example subsection)

F.5 Validation Procedure

Describe how the design team will validate that the final design meets the client's needs. This section should include a plan to meet with the client towards the end of the project to discuss final design details and demonstrate a prototype, experimental test, and/or simulation results. Provide a relative time frame for this validation to occur (e.g. "mid-March" or "early-April"). Include a brief discussion on how client feedback will be captured, such as a formal survey, interview, or observation notes of the client using the prototype. It may also include plans to solicit feedback from other stakeholders and/or potential users.

Section G. Results and Design Details

Use this section to highlight the major results of the design methodology described above including important analytical, computational, experimental, modeling, assembly, and testing results. This section should be one of the most substantial sections of the report showcasing all of the hard work and effort that went into the completion of the final design and delivery of the project deliverables. Show how the identified problem was solved.

Highlight the prominent features of the final design through analysis results, modeling, drawings, renderings, circuit schematics, instrumentation diagrams, flow and piping diagrams, etc. to show that the design functions as intended and meets all design objectives and constraints. Overview designs such as dataflow diagrams, process flow, swim lane diagrams, as well as presentation-layer designs (e.g. storyboards for front-ends) should be included here. Detailed designs such as database designs, software designs, procedure flowcharts, or pseudocode should be included here. Support computational and experimental results with key plots and figures. All supporting figures should be clearly labeled and annotated to highlight the most important points of the figure (i.e. explicitly point out what the reader should focus on or understand about the image).

Note that while all results should be used to help inform design decisions, not all results may be necessary to include in the main body of the report. Extraneous supporting results (e.g. graphs, data, design renderings, drawings, etc.) that are not necessary for presenting the fundamental findings can be placed in one or more appendices. Detailed documentation of each program module can be provided as appendix.

G.1 Modeling Results (example subsection)

G.2 Experimental Results (example subsection)

G.3 Prototyping and Testing Results (example subsection)

G.4. Final Design Details/Specifications (example subsection)

Note that while the design constraints and specifications may have provided minimum or maximum values, or ranges or values, that the design needed to meet, the final design specifications should be listed here showing that the required design values were met. A list of final design details can also be included demonstrate fulfillment of the design objectives.

Note: Preliminary results should be included in the Preliminary Design Report to show the progress made of the selected design concept to-date. This section should be updated for the Final Design Report to include documentation of all of the work that was completed on the project throughout the entirety of the academic year.

Section H. Societal Impacts of Design

In addition to technical design considerations, contemporary engineers must consider the broader impacts that their design choices have on the world around them. These impacts include the consideration of public health, safety, and welfare as well as the potential societal, political/regulatory, economic, environmental, global, and ethical impacts of the design. As appropriate for the project design, discuss how each of these considerations influenced design choices in separate subsections. How will the design change the way people interact with each other? What are the political implications of the design? Does the technology have the potential to impact or shift markets? Does the design have any positive or negative effects on the environment? Don't forget to consider unintended consequences such as process or manufacturing byproducts. What impacts might the design have on global markets and trade? Are there any ethical questions related to the design?

While it is hard to forecast the various impacts of a technology, it is important to consider these potential impacts throughout the engineering design process. When considered during the early stages of the design phase, consideration of these impacts can help determine design objectives, constraints, and specifications and help drive design choices that may mitigate any potential negative impacts or unintended consequences.

Note: A minimum of 4 of these design considerations, including the consideration of public health, safety, and welfare, are required for the Preliminary Design Report while a section for all considerations must be included in the final design report.

H.1 Public Health, Safety, and Welfare

Provide a list of all design safety features and provide a brief description of each. Discuss the potential effects the design may have on public health, safety, and welfare. References to the codes and standards previous provided and the organizations that produced them may be summarized or referenced here.

H.2 Societal Impacts

H.3 Political/Regulatory Impacts

H.4. Economic Impacts

H.5 Environmental Impacts

H.6 Global Impacts

H.7. Ethical Considerations

Section I. Cost Analysis

Provide a simple cost analysis of the project that includes a list of all expenditures related to the project. If an experimental test set-up or prototype was developed, provide a Bill of Materials that includes part numbers, vendor names, unit costs, quantity, total costs, delivery times, dates received, etc. Do not forget to include all manufacturing costs incurred throughout the completion of the project. If the design is expected to become a commercial product, provide a production cost estimate including fixed capital, raw materials, manufacturing (including tooling and/or casting), and labor costs to produce and package the device. Note that this type of detailed cost analysis may be listed as a project deliverable.

Note: The Preliminary Design Report should include all costs incurred to date. It is expected that this section will be expanded and updated between the preliminary and final design reports.

Section J. Conclusions and Recommendations

Use this section to summarize the story of how the design team arrived at the final design. Focus on the evolution of the design through the use of the engineering design process including lessons learned, obstacles overcome, and triumphs of the final design. Revisit the primary project goals and objectives. Provide a brief summary of the final design details and features paramount to the function of the design in meeting these goals and objectives.

A discussion may be included to discuss how the design could be further advanced or improved in the future. If applicable, summarize any questions or curiosities that the final results/design of this effort bring to mind or leave unanswered. If this project might continue on as a future (continuation) senior design project, detail the major milestones that have been completed to date and include any suggested testing plans, relevant machine drawings, electrical schematics, developed computer code, etc. All relevant information should be included in this section such that future researchers could pick up the project and advance the work in as seamless a manner as possible. Documents such as drawings, schematics, and codes could be referenced here and included in one or more appendix. If digital files are critical for future work, they should be saved on a thumb drive, external hard drive, cloud, etc. and left in the hands of the project advisor and/or client.

Appendix 1: Project Timeline

Provide a Gantt chart of similarly composed visual timeline showing the start and end dates of all completed tasks and how they are grouped together, overlapped, and linked together. Include all senior design requirements including design reports and Expo materials (i.e. Abstract, Poster, and Presentation). All major milestones should be included in the timeline.

Task Name	Start Date	End Date	Duration (days)	Status
Team Contract	08/26/2024	09/06/2024	11	Completed
Planning Phase	09/06/2024	10/13/2024	37	Completed
Define Scope	10/06/2024	10/08/2024	2	Completed
Identify Resources	10/06/2024	10/08/2024	2	Completed
Project Proposal	09/06/2024	10/11/2024	35	In progress
Fall Design Poster	10/11/2024	11/15/2024	34	Not started
Development Phase	TBA	TBA	TBA	Not started
Design Prototypes	TBA	TBA	TBA	Not started
Preliminary Design Report	11/15/2024	12/09/2024	25	Not started
Develop Core System	TBA	TBA	TBA	Not started
Testing Phase	TBA	TBA	TBA	Not started
Abstract for Expo	TBA	03/28/2025	TBA	Not started
Poster file for Expo	TBA	03/28/2025	TBA	Not started
Unit Testing	TBA	TBA	TBA	Not started

User Testing	TBA	TBA	TBA	Not started
Final Report	TBA	05/02/2025	TBA	Not started

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***
Samual Hodges	- Persistence - Punctuality - Likes to research - Open mindedness	Will spend hours figuring out the best way to implement something.	hodgessr3@vcu.edu
Katherine Parkyn	- Dedication - Communication - Adaptability - Interpersonal skills	Always excited to learn more about topics. Deadlines and schedules help me stay organized.	parkynkh@vcu.edu
Noor Tabanjeh	-time managing -creative -adaptability -passionate	Very passionate about starting new projects and meeting new people, and always ready to face different problems.	tabanjehnm@vcu.edu
Alan Velasquez	- Organized. - Efficient. - Proactive. - Quick learner.	Highly motivated to take on new challenges, and ready to adapt to any upcoming problems.	velasquezaj@vcu.edu

Other Stakeholders	***Notes***	***Contact Info***
Tom Arodz	Associate Professor, Department of Computer Science *and* Co-Director, VCU Center for Microbiome Engineering and Data Analysis	tarodz@vcu.edu

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***
Being on time to meetings	- Set up meetings in shared calendar - Send reminder on discord message day before and day of meeting	- Student misses first meeting, will be contacted for a reschedule or explanation - Student miss meetings afterwards – warning will be given - Student continues to miss meetings after warning. Faculty advisor will be contacted
Communicating 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. - Student is unresponsive when contacted.
Mutual Respect	- Speak/communicate professionally - Ensure any critique is constructive	- Speaking unprofessionally to another team member - Making criticism personal rather than about work completed

	- Be mindful of other team members time	
Communicate any major changes to the project prior to implementation	- If you make a change to the project that affects other group members, let them know so they can make appropriate changes to their own portion of the project via email or discord messages.	- Warning will be given via discord/email - Discuss if changes could possibly be undone - If changes keep being made without warning, faculty advisor will be notified

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	Every Thursday after 5 pm, On Discord Voice Channel	Update group on day-to-day challenges and accomplishments via discord (Kate will record weekly meetings for progress reports with advisor)
Students Only	As needed on discord, potentially 1x/week	Actively work on project as a team/hold scheduled work sessions. Individuals can suggest these as needed.
Students + Faculty advisor/Project Sponsor	Zoom call, potentially 1x/week, possibly 1x/2 weeks	Update faculty advisor and get answers to our questions (Kate can record these)

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***
Samual Hodges	Systems Engineer	- Analyze design specifications making updates as needed if requirements change - Make sure every members portion of the projects follows the defined specifications - Manage the integration of each portion into a working prototype
Kate Parkyn	Logistics Manager	-Keep a detailed record of meeting notes and share with group -Aid team members in staying updated regarding group correspondence - Aid in management of group calendar/scheduling
Noor Tabanjeh	Manufacturing Engineer	- Coordinate all fabrication processes to meet final prototype requirements. - Review designs to confirm they are optimized for manufacturing. - Develop and oversee the manufacturing schedule.
Alan Velasquez	Project manager	-Create reminders for group meetings, deadlines, and other necessities -Review progress being made and act accordingly -Create a respectful environment for team interactions

Step 5: Agree to the above team contract

Team Member: Samual Hodges *Signature: Samual Hodges*

Team Member: Kate Parkyn *Signature: Katherine Parkyn*

Team Member: Noor Tabanjeh *Signature: Noor Tabanjeh*

Team Member: Alan Velasquez *Signature: Alan V.*

Appendix 3: [Insert Appendix Title]

Note that additional appendices may be added as needed. Appendices are used for supplementary material considered or used in the design process but not necessary for understanding the fundamental design or results. Lengthy mathematical derivations, ancillary results (e.g. data sets, plots), and detailed mechanical drawings are examples of items that might be placed in an appendix. Multiple appendices may be used to delineate topics and can be labeled using letters or numbers. Each appendix should start on a new page. Reference each appendix and the information it contains in the main text of the report where appropriate.

Note: Delete this page if no additional appendices are included.

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] VCU Writing Center. (2021, September 8). *APA Citation: A guide to formatting in APA style.* Retrieved September 2, 2024. https://writing.vcu.edu/student-resources/apa-citations/
[2] Teach Engineering. *Engineering Design Process*. TeachEngineering.org. Retreived September 2, 2024. https://www.teachengineering.org/populartopics/designprocess