VCU College of Engineering

CS-25-320: AR/WebXR for Public Engagement on NASA's Psyche Mission

Project Proposal

Prepared for

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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.

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Section A. Problem Statement

AR/WebXR for Public Engagement on NASA's Psyche Mission

NASA and space exploration is an exciting field of study, and NASA's Psyche mission is one of the latest operations that hopes to uncover some of the mysteries of our solar system. Psyche is a metal-rich asteroid in the asteroid belt, and by studying it, scientists hope to learn more about planetary cores and the early stages of planet formation. It's a crucial mission to gain an understanding of the cosmos, but unfortunately, its complexity deters interest from the general public and people don't understand the challenges it faces. This project aims to bridge that gap by developing AR and WebXR experiences to bring Psyche's story to life for everyone, including those who aren't scientists (Psyche Mission FAQ, 2023).

Professor Cassie Bowman, the project sponsor from ASU, hopes to display this AR/WebXR experience in museums, where visitors like kids and families can dive into a virtual orbit around Psyche! After scanning a QR code with their smartphones, museum guests can interact with a large 3D-printed model of the asteroid, exploring its surface and gathering data as if they were part of the mission. Visitors will also have the option to enjoy other experiences like a virtual scavenger hunt! This hands-on experience aims to make learning about Psyche accessible and engaging, taking museum interactions to another level (NASA, 2021).

Project Background and Context

In recent years, AR and WebXR have transformed how people learn and explore. These technologies allow us to simulate experiences that would otherwise be impossible due to cost or safety limitations (Virtual and Augmented Reality Technologies, 2021). The Psyche mission, presents a unique opportunity to make complex scientific information more understandable and exciting, closing the distance from NASA's research and the general public in a fun new way.

While NASA has always tried to engage the public with various types of media, such as videos and live streams, this project takes things further. By using AR and WebXR, we're creating an immersive way for the public to "orbit" around the asteroid and learn about the mission in fun interactive ways (Fuel Your Digital, 2024). The reason why virtual experiences aren't being used for interactive learning to the masses is due to their complexity, but luckily the times have changed and AR/WebXR has improved immensely. Due to user-friendly and free programs like Unity, we will be able to complete our virtual project within our timeframe without complications (Unity, n.d.).

Addressing Unmet Needs and Advancing Technology

There's a big need for interactive and engaging educational tools that can make space exploration accessible to everyone. Often, the public finds it difficult to connect with these distant missions. The general public sees space exploration as a distant endeavor that they wouldn't even be able to fathom. This project aims to change that by making scientific content about Psyche easy to understand and enjoyable. Using AR and WebXR technology, we hope to

reach a wide audience, bringing the Psyche mission to life in places like museums and schools (Azadmanesh, Roshanian, & Hassanalian, 2023).

This project also represents a big step forward in the field of space education. By combining physical 3D models, QR codes, and virtual experiences, we're exploring new ways to make scientific content more accessible and engaging. Plus, since WebXR can be accessed from most smartphones, we're able to bring this experience to people around the world, regardless of their location or budget (Psyche Mission FAQ, 2023).

Stakeholders and Potential Impact

The key contributors to this project include ASU, NASA, VCU's Computer Science Department, and our museum visitors and educators. NASA and ASU benefit from an increase in public engagement and inspire interest in space exploration. For museums, this project offers an innovative way to attract and engage visitors, particularly families and young children who might not be as interested in traditional exhibits. The project also provides a fantastic resource for educators, offering them a new tool to help students get excited about STEM (NASA, 2021).

We believe this project could make a significant impact by increasing public interest in space exploration. It might also inspire similar AR/WebXR projects for other space missions in the future. The virtual nature of the project means it's cost-effective and environmentally friendly, and it helps promote STEM to our next generation by making science more approachable (Fuel Your Digital, 2024).

Historical Perspective and Previous Work

There have been other AR and WebXR projects, like the Smithsonian's AR experience for the Apollo 11 mission, which shows that these technologies are valuable educational tools. However, most of these projects focus on past missions rather than ongoing ones. With this project we're bringing a real-time connection to an active mission like Psyche into public spaces, making it a unique addition to space education.

By blending AR/WebXR with NASA's space exploration goals, this project offers an exciting new way to engage the public. We hope that by giving museum visitors and other interested parties an interactive way to experience and learn about the Psyche mission, we can make space exploration feel more accessible and help them better understand what the mission truly entails.

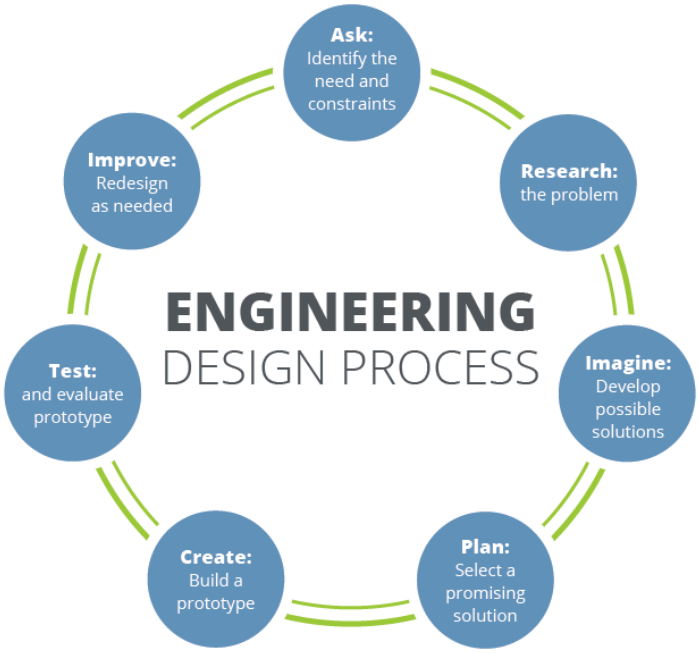

Figure 1. The iterative nature of the engineering design process [2].

Section B. Engineering Design Requirements

This section includes information on our general project goals, design objectives, design specifications and constraints, and finally, the codes and standards our project will adhere to. This provides the general outline for how our project will be handled. Each section has a detailed description of the contents of that section, along with the specified requirements. The codes and standards section and design requirements section will be updated as needed as the project progresses into development.

Note: The design requirements should be revisited between major reports to ensure that the design objectives and constraints still accurately reflect the client needs and project goals and to make sure that the team is on track to meet all goals and objectives.

Note: The codes and standards section is not required for the Project Proposal, but is required for all subsequent reports. This section should be comprehensive and thorough, requiring a significant research effort.

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

This section includes information about our overall goals. These goals were set by the sponsor during our first meeting and within the project description provided to us. Our set goals are as follows:

- To produce short experiences related to the Psyche asteroid
- To provide information about Psyche asteroid through WebXR/AR experiences
- To use the created short experiences around the world in museums and learning environments

B.2 Design Objectives

This section lists the key objectives of our design that we will produce. These objectives have been described through the SMART format. The objectives that have been outlined in this section were discussed throughout advisor and group meetings, and approved by the sponsor. The objectives are as follows:

- The design will be WebXR/AR experiences pertaining to the Psyche asteroid, having multiple different facts related to the asteroid and the technology used to measure it. These experiences will be used as a quick and fun way for people of all ages to get facts about Psyche.

- The design will have 2 web experiences and 2 AR experiences.
- The design is achievable, as we will have access to a Meta headset and will have access to online and in-person resources pertaining to WebXR/AR
- This design will follow a timeline where our first 2 WebXR experiences will be completed within the next couple months with our next 2 experiences as a work in progress, and our final 2 experiences will be completed before the Capstone EXPO.

B.3 Design Specifications and Constraints

This section includes information on our design specifications and constraints that we have to adhere to while designing our project. Our project must not violate any constraints listed, and our project must be tested thoroughly to fit the specifications listed below. These constraints were chosen based on our decided experiences and constraints previously discussed. Our design specifications and constraints are as follows:

- Design must be made with accessible headsets and hardware, such as Meta Quests and Phones, to be accessible for public use
- Design must be short (1 minute or less) and easy to interact with
- Design should provide the same information even without access to the headset, if necessary
- Design should be easily navigable by people of all ages, and will be tested by having people of various ages and technology skill sets test our experiences and provide feedback.

B.4 Codes and Standards

This section is on standards and codes that our design must follow in order to ensure quality, reliability, and safety. We have a mixture of codes and standards to follow which allow us to hold our designs to a high standard. The research for these codes and standards were based on the design specifications and the use of copyrighted logos, such as NASA and ASU. The codes and standards are as follows:

- WCAG (Web Content Accessibility Guidelines) 2.0 - design components must be accessible to users with disabilities
- ISO/IEC Standard No. 5927 - design components must adhere to safe immersion standards for augmented reality
- U.S Code: Title 17 - design components will not infringe on copyright laws and licenses

*This section will be updated as necessary

Section C. Scope of Work

This section outlines our key objectives, timeline, milestones, and deliverables, while clearly defining team responsibilities and the process of verifying and approving work. In addition to stating the team's duties, it also specifies tasks outside of our responsibilities and sets boundaries on things such as the project timeline, budget, and development methodology.

C.1 Deliverables

- **Core Experience Prototypes**
    1. ***Orbit:*** *A virtual dive orbiting the Psyche*
    2. ***WebXR Scavenger Hunt:*** An interactive hunt where players find and collect items about the Psyche mission with educational facts.
    3. ***Mission to Psyche (VR Experience):*** An immersive VR experience simulating the mission to Psyche. Includes interactive terrain and educational mini-games.
    4. ***Asteroids (The Game):*** An AR game where users collect asteroids and learn facts about Psyche.
    5. ***VR Life Size Asteroid:*** A VR experience that places users on Psyche and allows them to explore its surface and learn fun facts about the mission.
    6. ****Other Protypes that may appear in the future****

- **User Documentation**
  Manuals explaining how to complete/navigate the WebXR and VR experiences along with deployment instructions for public use.

- **Code Base and Repository**
  The Github repository with proper documentation, comments, and instructions/recommendations for future development.

- **Academic Reports**
    1. *Team Contract*
    2. *Project Proposal*
    3. *Design Reports*
    4. *Posters*
    5. *Presentations*

- **User Testing Report**
  A report on user testing with feedback from beta testers and how it can be used to improve the project.

C.2 Milestones

Milestones are major project phases or tasks that need to be completed in order to ensure the project deliverables. They may include, among other things, completion of calculations, the development of a computational model, completion of an analysis, set-up of an experiment, completion of data acquisition, purchasing of hardware, assembly of a prototype, completion of testing procedures, development of required code, completion of wiring, post processing, etc.

A good rule of thumb is to break the project down into tasks of no larger than 2-3 weeks in length. These can be individual or group tasks. Breaking down the project into tasks/milestones gives the team and the advisor/sponsor a realistic understanding of what can be done in the allotted time. In an agile development approach, later tasks are expected to be adjusted (or changed) as the team works with the earlier developed tasks.

The amount of time it will take to accomplish each milestone and the approximate date that each milestone will be completed should be considered. Do not underestimate the time that it takes to write and prepare major reports and presentation materials. All deliverables and milestones should be included in the project timeline found in Appendix 1. Provide a summary table of all project milestones including required times and completion dates here.

Note: While the project scope, deliverable, and milestones are not intended to change throughout the project, this section should be revisited between major reports to ensure that it still accurately reflects the expectations and requirements of the project team, client, and faculty advisor. Any changes to the project scope, deliverable, and milestones should be thoroughly discussed and mutually agreed upon by all parties. Any changes to this section should be documented and justified in detail.

September Milestones

- ☑ Meet team/sponsor/advisor
- ☑ Establish roles and responsibilities
- ☑ Set up discord
- ☑ Complete team contract
- ☑ Create Github repository
- ☑ Study Psyche mission
- ☑ Brainstorm ideas for AR/WebXR projects

October Milestones

- ☑ Present ideas to advisor/sponsor
- ☐ Finish Project Proposal

November Milestones

- ☐ Complete WebXR Scavenger Hunt (Full month to complete

December Milestones

- ☐ Debug/Fix WebXR Scavenger Hunt

January Milestones

- ☐ Complete another experience

February Milestones

- ☐ Debug/Fix experience created in the previous month

March Milestones

- ☐ TBD

April Milestones

- ☐ TBD

May Milestones

- ☐ PRESENT PROJECT!!!

C.3 Resources

Software:

- *Unity* (for VR experiences)
- *Blender* (for 3D modeling)
- *Three.js, A-Frame, or Babylon.js* (for WebXR)
- *IDEs* (Microsoft VS Code, Unity Editor)

Hardware:

- *VR Headset* (MetaQuest 3)

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

Sprint 1: Setting Up	Week 1			Week 2			Week 3		
Task Name	**9/3**	**9/5**	**9/6**	**9/10**	**9/12**	**9/13**	**9/17**	**9/19**	**9/20**
Meet team/sponsor/advisor									
Established Roles									
Set up Discord									
Team Contract									
Created GitHub Repo									
Finished GitHub setup									
Studied Psyche Mission									
Brainstorm Ideas for AR/WebXR									

Sprint 2: Research	Week 1			Week 2			Week 3		
Task Name	**10/1**	**10/3**	**10/4**	**10/8**	**10/10**	**10/11**	**10/15**	**10/17**	**10/18**
Present ideas to advisor									
Find Sources									
Finish Project Proposal									

Major Deliverables	Sprint 1			Sprint 2			Sprint 3			Sprint 4		
Task Name	**9/3**	**9/5**	**9/6**	**10/8**	**10/10**	**10/11**	**11/12**	**11/14**	**11/15**	**12/9**		
Team Contract												
Finish Project Proposal												
Fall Design Project												
Preliminary Design Report												

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***
Ankita Sahu	*communication, experience, UI/UX design, art background*	*i work best under pressure, also i love cats*	*sahua3@vcu.edu 650-669-7274*
Adonias Daniel	*Communication, creative design, organization, front and backend*	*I like to be ahead, and get work done early. I like cats. I have some experience with AI and creating websites!*	daniela10@vcu.edu 571-426-9840
Andre Smith III	*Good communication, project planning, UI/UX design*	*I like to plan projects as best as possible to decrease stress and confusion later in projects.*	*smithaa9@vcu.edu 757-240-8902*
Santiago Blanco	Industry experience, large team collaboration, UI/UX	I love cats too! Previous experience with capstone work, website designer freelancer, full stack project experience	blancos2@vcu.edu 571-526-8498

Other Stakeholders	***Notes***	***Contact Info***
Advisor: Rodrigo Spinola	*Professor for 355, nice professor who taught us a lot!*	*spinolaro@vcu.edu*
Sponsor: Cassie Bowman	Professor at ASU, Lead Sponsor for NASA Psyche Mission	cbowman5@asu.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 every meeting	• *Set up meetings in shared calendar* • *ping everyone when we decide a meeting time* • *ping 30 minutes before and at the start of a meeting as a reminder*	• *Student misses first meeting, warning is granted* • *Student misses meetings continuously – issue is brought up with faculty advisor* • Missing a meeting with no communication
Communication	• *Stay up to date with each other's task for project* • *Set reasonable deadlines and note when an extension is needed through one of the communication methods* • *know when to ask a question/ask for help*	• *Student shows up for weekly meeting with no considerable work done* • Student does not respond questions • Student is not being communicative on his work
Collaboration Effort	• *Make sure everyone is putting in the same effort* • *110% effort on your work* • *Everyone is completing their responsibilities and tasks efficiently*	• *Student doesn't complete tasks by their assigned due date* • *Student relies on others work causing unbalanced collaboration*

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 weekly*	*Update group on day-to-day challenges and accomplishments (Avery will record these for the weekly progress reports and meetings with advisor)*
Students Only	*Every Monday 11-12 in East engineering building near ram bytes*	*Actively work on project (Alex will document these meetings by taking photos of whiteboards, physical prototypes, etc, then post on Discord and update Capstone Report)*
Students + Faculty advisor	*weekly meetings (TBA)*	*Update faculty advisor and get answers to our questions (All members should attend these meetings to make sure everyone is up to date)*
Project Sponsor	*Once a month (TBA)* *If sponsor is available, we'll figure out Zoom or in person details* *If not, then we'll update the sponsor via email.*	*Update project sponsor and make sure we are on the right track*

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
Santiago Blanco	*Project Manager*	- *Keep a detailed record of meeting notes and share with group* - *Make sure everyone understands what is going on* - *Lead the conversation and submit assignment* - *Ensure proper collaboration to reach deadlines*
Adonias Daniel	*Logistics Manager*	- *Facilitate and manage communication channels to ensure timely and effective exchanges of information.* - *Monitor and enforce compliance with internal policies and procedures related to logistics and resource management.* - *Analyze logistics data to identify areas for improvement and recommend changes to enhance efficiency.* - *Assist in any technical needs*
Andre Smith	*Technical Engineer*	- *Collaborate with team to assist with any technical needs* - *Lead with any research on technical aspects of the project*
Ankita Sahu	*Lead Designer*	- *Working on creating a intuitive and appealing experience* - *Figure out theming, color schemes, the UI/UX layout, etc and implementing it*

Step 5: Agree to the above team contract

Team Member: Adonias Daniel *Signature: Adonias Daniel*

Team Member: Ankita Sahu *Signature: Ankita Sahu*

Team Member: Andre Smith III *Signature: Andre Smith III*

Team Member: Santiago Blanco *Signature: Santiago Blanco*

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

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