Team 314: Gen AI VR FAMU-FSU CoE

Museum

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Abstract

The AI VR COE Museum is a Virtual Reality experience designed to inspire curiosity and creativity by blending art and STEM in an immersive way. This project creates a space where visitors can explore the deep connection between artistic expression and scientific innovation through interactive exhibits. Built using the Unity game engine and designed for the Metaquest 3 VR headset, the museum combines cutting-edge technology with thoughtful storytelling. Visitors can dive into rooms like the history of AI, an interactive game showcase, a COE history exhibit, and a classical music experience, each offering something unique to discover. The exhibits respond to user interaction, playing sounds or changing visuals to create a fully engaging environment. AI plays a crucial role in shaping the museum, helping design exhibits that are dynamic and continually evolving. With this project, we aim to show how art and science complement each other and encourage students, educators, and VR enthusiasts to see the endless possibilities of their integration. Whether you're an engineering student, a young learner, or simply curious about the future of technology and creativity, this museum offers an experience that's both educational and inspiring.

Keywords: Innovative , Immersive, Educational, Interactive, Artistic

Disclaimer

Pre-existing Medical Conditions

People who have previous medical conditions such as severe headaches, ear-aches, or psychiatric disorders, should see a doctor before playing on our VR application. Some people may experience seizures triggered by flashing lights or patterns while experiencing virtual reality, even if they have never had a seizure before, or have no history of epilepsy or seizures. Anyone who knows or believes they may have previously experienced a seizure or other symptom linked to an epileptic condition should see a doctor prior to playing our VR application.

Motion Sickness

People who are prone to motion sickness have a risk of experiencing discomfort when using Virtual Reality. Do not play when you are sleep deprived, are under the influence of drugs or alcohol, or have digestive problems.

Safety guidelines

The Meta Quest should not be used by people who are pregnant, have certain medical conditions, or are prone to motion sickness. It is also not recommended for outdoor use. Some safety guidelines include:

- **Creating a safe space**: Clear the area of objects you won't be using and set up a boundary to prevent collisions.

Using the Guardian system: Set up the Guardian system to help you navigate your space safely.

Taking breaks: Take regular breaks when using the Meta Quest for fitness or wellness.

Stopping use: Stop using the Meta Quest if you experience discomfort or other unusual symptoms.

Acknowledgement

We would like to spend some time thanking everyone who has helped us in the various stages of our design process:

First of all, we would like to start by thanking our sponsor, Dr. Bernadin, for her unwavering support and guidance throughout this project. Her enthusiasm for combining art, science and technology inspired us to push our abilities to their utmost and develop something special. This project has given us the opportunity to develop numerous engineering skills that will carry over to various areas of our careers. The senior design process in general gives us an idea of how the engineering process will work in a professional setting and this specific project has given us an opportunity to pursue our interests, such as game design, which is something we are all passionate about. This project has also given us an opportunity to develop our software development skills, and this would not be possible without Dr. Bernadin's sponsorship.

We would like to give another thank you to our primary advisor, Dr. Migara, for his advice and contribution to the project in the past. This project is a passion project for Dr. Migara, who spent the summer creating a baseline for the museum that we were able to build off of and reference for an idea of what to do. Dr. Migara's advice has been critical in our design stage, and we would not have been able to construct a preliminary design without it. Being able to bounce ideas off of him and receiving feedback on our numerous assignments for our senior design class has helped us significantly in developing our design, and we would not have been able to do what we have without him.

We would also like to thank Dr. Chuy for his help and feedback during the design stage of our project. Dr. Chuy's feedback on our assignments, especially the customer needs and requirements, significantly helped us gain a better understanding of our project and how to implement it. His consistent effort to make sure we stayed on top of our design and his continuous willingness to provide input and advice has greatly helped us throughout this first semester of senior design.

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Table 1

No.	NEED/ STATEMENT	SOURCE
1	Need to involve Artificial Intelligence.	Customer
2	Needs to be displayed in Virtual Reality.	Customer
3	Needs to be interactive.	Customer
4	Needs to display historical and artistic exhibits.	Customer

Table shows customer needs provided by sponsor from needs and requirements

Table 2

	NEED	REQUIREMENT/ INTERPRETATION
1	1	AI shall help create and modify the exhibits.
2	1,3	The exhibits shall be designed for an immersive VR experience.
3	2,4	Shall have exhibits that change or play audio when users interact with them; shall implement voiced characters to interact with.
4	3,4	Visitors shall explore rooms dedicated to classical music, paintings, and sculptures, bringing the museum to life in an interactive 3D space.

Table shows the derived requirements and interactions between requirements and needs from needs and requirements

Table 3

Minor Functions	Major Functions				
		Generate Audio	Read User Input	Generate Visuals	Customer Needs
	Generative Scenery	-	-	**x**	**1,2**
	Animated walking mechanics	-	-	**x**	**2**
	Allow interaction with games	-	**x**	-	**1,2,3**
	Present educational exhibits	-	**x**	-	**2,4**

Cross Reference Table shows the minor and major functions from functional decomposition and their interactions between them

Table 4

Module	VR Museum
Inputs	Blender, unity
Outputs	3-D VR environment
Functionality	Create a VR environment of an educational/artistic museum for users to explore

Table shows the functional behavior of vr museum module from functional decomposition

Table 5

Module	Generate Visuals
Inputs	Generative AI, Unity, Blender
Outputs	Generative exhibits, animations, VR display
Functionality	Create immersion for users to feel more involved in the museum

Table shows the functional behavior of generate visuals module from functional decomposition

Table 6

Module	Read User Input
Inputs	Unity, C#, VR controller
Outputs	Playable games, educational exhibits
Functionality	Create exhibits that users can interact with through VR for a more entertaining experience

Table shows the functional behavior of read user input module from functional decomposition

Table 7

Module	Generate Audio
Inputs	Voice, Speech-to-text AI
Outputs	AI generated images, AI-generated voices/audio
Functionality	Incorporate generative AI so users can gain a better understanding of the use of AI in numerous functions

Table shows the functional behavior of generate audio module from functional decomposition

Table 8

Module	Generative scenery/exhibits
Inputs	AI
Outputs	AI generated maze, AI generated images, AI generated audio
Functionality	Create exhibits that are unique for each individual to demonstrate AI-generative capabilities

Table shows the functional behavior of generative scenery/exhibits module from functional decomposition

Table 9

Module	Walking animations
Inputs	Blender/3D modeling
Outputs	Animations and movement in Unity
Functionality	Develop a more immersive experience by providing movement mechanics

Table shows the functional behavior of walking animations module from functional decomposition

Table 10

Module	Playable games
Inputs	C#, Python, Blender, Unity, VR controller
Outputs	First-person Pacman, Connect-4, etc.
Functionality	Provide users with a more interactive experience by having games in certain exhibits

Table shows the functional behavior of playable games module from functional decomposition

Table 11

Module	Educational exhibits
Inputs	Blender, Unity
Outputs	Artistic and historical displays
Functionality	Give users an educational experience within the museum

Table shows the functional behavior of educational exhibits module from functional decomposition

Table 12

VR	Metaquest 3	Apple Vision Pro	Metquest Pro	Oculus	Playstation VR
AI	Incorporate multiple AI tools: ChatGPT, Suno, MidJourney	ChatGPT	Suno	MidJourney	Elevenlabs
Modeling	Animations/models in Blender	Use Maya for models	Use CAD for models	Use Sketchup for models	Use Cinema4D for renders
Interactivity	Include numerous types of interaction: games, spatial audio, generative exhibits	Add interactive games	Add interactive elements to existing exhibits	Spatial audio	Image generation
Artistic Expression	Add a variety of artistic forms	Focus more on painting/imagery	Focus on historical exhibits	Add musical expression	Add dancing/ expressive art exhibits
Engine	Unreal Engine	Unity	Godot	Lumberyard	CRYENGINE

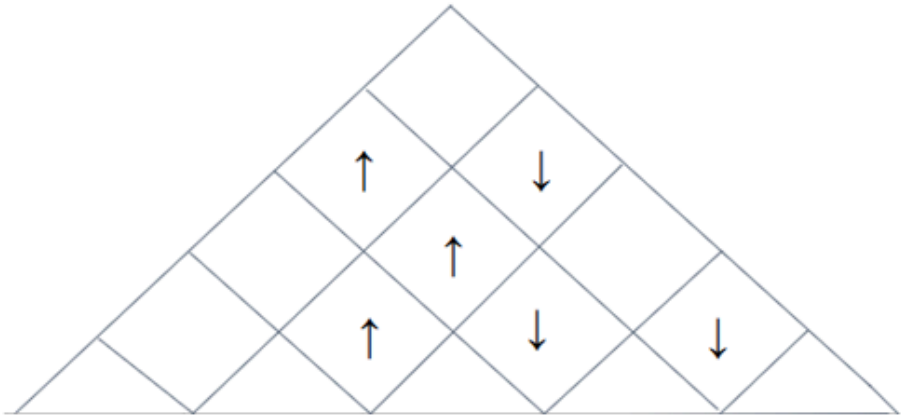
Table shows the morphological analysis from Concept Generation section

Table 13

1	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Metaquest 3 for VR headset
2	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Metaquest 3 for VR headset
3	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Metaquest 3 for VR headset
4	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Metaquest 3 for VR headset
5	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Apple Vision Pro for VR headset
6	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Apple Vision Pro for VR headset
7	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Apple Vision Pro for VR headset
8	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Apple Vision Pro for VR headset
9	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Metaquest 3 for VR headset
10	10/23/2024	Playstation VR used for VR headset
11	10/23/2024	Use Unity as a game engine and Blender for 3D modeling, use various generative AI tools, include various art forms
12	10/23/2024	Use an Oculus for the VR implementation
13	10/23/2024	Samsung HMD Odyssey
14	10/24/2024	Use Google Metaquest 3 for VR
15	10/24/2024	Use ChatGPT as AI tool
16	10/24/2024	Use Unreal Engine as a game engine and Blender for modeling, use the Metaquest 3, create artistic and historical exhibits
17	10/24/2024	Use Unity and Blender for modelling/animations, use the Metaquest 3 for the VR headset, include numerous generative AI tools such as ChatGPT, Midjourney, and Suno
18	10/24/2024	Use Suno for generative music and audio
19	10/24/2024	Use Google Gemini for generative AI
20	10/24/2024	Use ChatGPT for AI, use some other game engine
21	10/24/2024	Find another 3D modelling tool other than Blender
22	10/24/2024	Use other game and modelling engines than the ones provided, use a headset other than the Metaquest
23	10/24/2024	Use Unreal Engine as a game engine and Blender for modeling, use a headset other than the Metaquest 3 and use various types of AI
24	10/24/2024	Small Room: All models are small, making player feel big
25	10/24/2024	Space Room: Show planets and sun to scale
26	10/24/2024	VR Meteor Shower in space room
27	10/24/2024	Balloon Gun: Inflate balloons with trigger, let go and they float
28	10/24/2024	Upside-Down Room: Inverted Gravity Room
29	10/24/2024	Black Hole Simulator: In space room
30	10/24/2024	AI design a planet: AI generated planet images based off user input
31	10/24/2024	Climbable DNA Helix: Genetics exhibit
32	10/24/2024	Bug Room: Shrink down and look at bugs / bug POV
33	10/24/2024	Animal Room: Miniature Zoo, AI generated animals?
34	10/24/2024	Painting Room: Paint on a canvas, AI generates an alternate version?
35	10/24/2024	Space Station Room: Feel like you're on a spaceship with zero gravity
36	10/24/2024	Ocean Exploration Room: Fish and reefs, feels like you're underwater
37	10/24/2024	VR Roller Coaster: goes throughout the museum
38	10/24/2024	Interactive Volcano Room: goes off at random times
39	10/24/2024	Timed Museum Events: event happen around the museum and are announced for visitors to find
40	10/24/2024	Use Unreal Engine as a game engine and Blender for 3D modeling, use various generative AI tools, include various art forms
41	10/24/2024	AI or Real? Quiz with AI images if they are real/from an artist or AI
42	10/24/2024	Experimental Gravity room: Change gravity with a lever that users can control
43	10/24/2024	AI Music Room : Music Generated by AI
44	10/24/2024	AI Art Generator Gallery: Create real time AI-generated art
45	10/24/2024	AI-Powered Language Translator Room: Translate speech with AI in real time
46	10/24/2024	VR Escape Room: Solve puzzles related to exhibits to escape a themed room.
47	10/24/2024	AI History Quiz Game: Participate in AI-generated quizzes about exhibits for rewards.
48	10/24/2024	AI Biodiversity Exploration: Explore ecosystems and endangered species with AI simulations.
49	10/24/2024	Museum Detective with AI: Solve art thefts or historical mysteries using AI-generated clues.
50	10/24/2024	Game of Inventions by AI: Explore groundbreaking inventions with AI-enhanced storytelling.
51	10/24/2024	Sports history room with interactive sports
52	10/24/2024	Fantasy Exhibit: Explore a whimsical museum with mythical and fantastical elements.
53	10/24/2024	Literature room - history of literature and AI generated images
54	10/24/2024	Olympics room - history of olympics back to Greece
55	10/24/2024	AI Sculpting: Create and manipulate sculptures using AI design tools.
56	10/24/2024	Interactive basketball hoop and ball
57	10/24/2024	Interactive avatars of historical artists
58	10/24/2024	Photo Challenge: Capture virtual "photographs" of specific exhibits or artifacts.
59	10/24/2024	Artifact Discovery with AI: A scavenger hunt guided by AI clues to find hidden artifacts.
60	10/24/2024	Architectural Analysis by AI: Explore famous buildings with AI-generated insights on design and history.
61	10/24/2024	Time-travel mechanics to investigate historical context
62	10/24/2024	VR Meditation Space: Experience calming virtual environments tied to cultural practices.
63	10/24/2024	AI generated alternate history of art
64	10/24/2024	Art Critique by AI: Engage in discussions about artworks with AI-generated critiques.
65	10/24/2024	AI Storytelling Paths: Choose your own adventure as narratives unfold based on AI algorithms.
66	10/24/2024	AI Generated Maze Exhbit: Find your way through procedurally generated mazes.
67	10/24/2024	AI Mythology Adventures: Learn about different mythologies through AI-enhanced storytelling.
68	10/24/2024	Seasonal AI Events: Engage in seasonal activities with AI-generated themes from various cultures.
69	10/24/2024	AI Character Creation: Design historical figures with AI, altering their attributes and stories.
70	10/24/2024	AI Language Translation: Explore exhibits in multiple languages with real-time AI translation.
71	10/24/2024	VR Research Lab: Conduct virtual experiments with AI analyzing outcomes and data.
72	10/24/2024	Historical Scenario Simulations: Participate in AI-driven simulations of pivotal historical moments
73	10/24/2024	Cultural Cuisine Experience: Cook virtual meals with AI guidance based on historical recipes.
74	10/24/2024	Artifact Reconstruction: Use AI to visualize how ancient artifacts were originally used.
75	10/24/2024	Use Elevenlabs for AI implementation
76	10/24/2024	Crisis Simulation Games: Engage in AI simulations that place you in historical crises to understand decision-making.
77	10/24/2024	AI Historical Timeline: Create dynamic timelines that adapt based on user choices and interactions.
78	10/24/2024	Customized Learning Paths: Follow AI-curated educational paths based on personal interests and knowledge levels.
79	10/24/2024	Interactive Historical Maps: Explore AI-generated maps that reveal hidden stories behind locations
80	10/24/2024	AI Museum Trivia Night: Participate in a trivia game where AI generates questions based on exhibits.
81	10/24/2024	AI Reflection Rooms: Experience meditative spaces that use AI to adapt to your mood.
82	10/24/2024	AI Ethics Workshop: Participate in discussions on the ethical implications of AI in society.
83	10/24/2024	Creative Writing Prompts: Receive AI-generated prompts inspired by exhibits for creative writing.
84	10/24/2024	Virtual AI Gardening: Cultivate virtual gardens inspired by historical botany using AI guidance.
85	10/24/2024	Personalized Exhibit Recommendations: AI suggests exhibits based on visitor interests and preferences.
86	10/24/2024	AI Voiceovers for Artworks: Listen to AI-generated audio guides that provide insights about specific pieces.
87	10/24/2024	Virtual AI Historical Debate Club: Engage in debates on historical topics, moderated by AI.
88	10/24/2024	AI-Enhanced Cultural Dialogues: Participate in AI-facilitated discussions about cultural understanding and history.
89	10/24/2024	AI-Generated Soundscapes: Create personalized soundscapes that reflect your experience within the museum.
90	10/24/2024	Virtual Reality Language Labs: Practice languages with AI characters in immersive settings related to cultural exhibits.
91	10/24/2024	AI-Powered Music Experiences: Explore music history with AI creating playlists that reflect historical eras.
92	10/24/2024	Virtual Reality Treasure Hunts: Use AI clues to uncover hidden treasures in themed museum exhibits.
93	10/24/2024	AI-Generated Documentary Experiences: Participate in interactive documentaries that blend storytelling and education.
94	10/24/2024	Virtual Reality Reenactments: Experience and participate in reenactments of historical events guided by AI.
95	10/24/2024	AI-Powered Personal Journals: Keep a virtual journal of your experiences, with AI providing insights and reflections.
96	10/24/2024	AI Language Evolution Exhibit: Explore how languages have evolved using AI-generated linguistic data.
97	10/24/2024	Interactive Environmental History: Explore the impact of humans on the environment through AI-driven simulations.
98	10/24/2024	Digital Reconstruction of Historical Sites: Explore AI-generated reconstructions of significant historical locations.
99	10/24/2024	Virtual Reality Cross-Cultural Collaborations: Engage in projects that merge different cultural perspectives through AI.
100	10/24/2024	Interactive Philosophy Workshops: Explore philosophical questions through AI-facilitated discussions related to historical events.

Table shows the 100 initial concepts from the Concept Generation section

Table 14



		Efficient programming Language	High quality VR headset	3D Modeling	Smooth Experience	Cost
		+	+	+	+	-
Use of AI	+	↑			↓	↓
VR	+		↑↑	↑	↑	↓↓
Interactivity	+	↑↑	↑		↓	
Artistic Expression	+		↑	↑↑	↓	
Targets		Time between interactions and program ≤2 sec	Resolution of 1080x1200	User survey with 80% satisfaction	FPS >72	Budget of $500

Table shows the House of Quality from the Concept Selection section

Table 15

		Concept 1	Concept 2	Concept 3	Concept 4
Use of AI	2	-	0	-1	0
VR Headset	3	-	0	-1	-1
Game Engine	5	-	-1	-1	0
3D modeling	1	-	0	0	0
Artistic Expression	2	-	0	0	0
Score		-	-1	-3	-1
Continue?		Yes	No	No	No

Table shows the Pugh Chart from the Concept Selection section

Table 16

Criterion	Weight	Concept 1	Concept 2	Concept 3	Concept 4
Use of AI	0.4	0.52	0.201	0.079	0.201
VR Headset	0.2	0.6	0.2	0.1	0.1
Game Engine Accessibility	0.15	0.7	0.1	0.1	0.1
3D Modeling	0.15	0.5	0.2	0.15	0.15
Artistic Expression	0.05	0.5	0.2	0.15	0.15
Total Score		0.558	0.1854	0.1041	0.1529

Table shows the Analytical Hierarchy Process from the Concept Selection section

Table 17-19

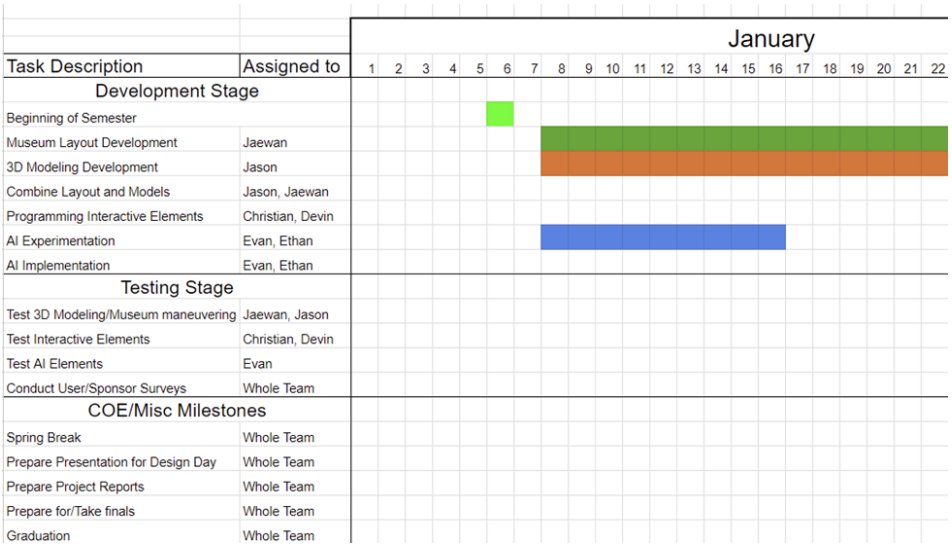
	Concept 1	Concept 2	Concept 3	Concept 4	Column Sum
Concept 1	1	3	5	3	12
Concept 2	1/3	1	4	2	7.33
Concept 3	1/5	1/4	1	1/3	1.783
Concept 4	1/3	1/2	3	1	4.833

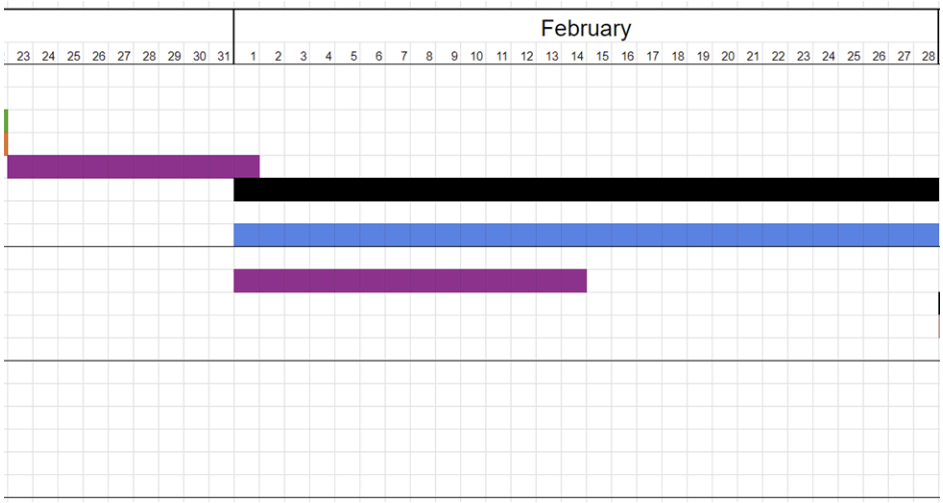
	Concept 1	Concept 2	Concept 3	Concept 4
Concept 1	1/12 = **0.083**	3/7.333 =**0.409**	5/1.783 = **0.28**	3/ 4.833 = **0.621**
Concept 2	0.33/12 = **0.028**	1/7.33 = **0.136**	4/1.783 = **0.224**	2/ 4.833 = **0.069**
Concept 3	0.2/12 = **0.017**	0.25/7.33 = **0.034**	1/1.783 = **0.056**	0.33 / 4.833 = **0.069**
Concept 4	0.33/12 = **0.028**	0.5 / 7.333 = **0.068**	3/1.783 = **0.168**	1/ 4.833 = **0.207**

	Row Sum	Row Average
Concept 1	1.393	1.393/4 = 0.52
Concept 2	0.802	0.802/4 = 0.201
Concept 3	0.176	0.176 /4 = 0.079
Concept 4	0.802	0.802 / 4 = 0.201

The three tables above show the process for determining the values in the Analytical Hierarchy Process table

Table 20

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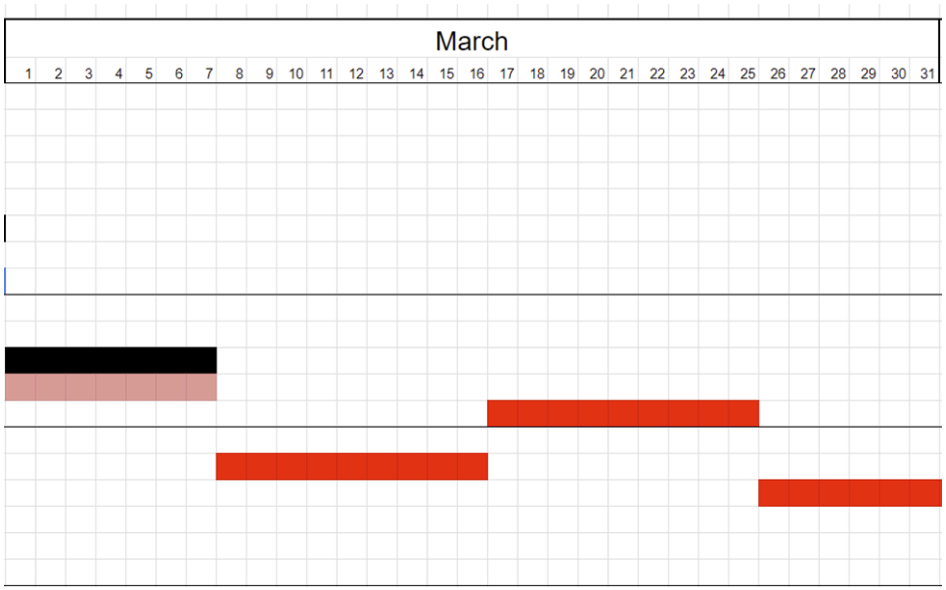
March
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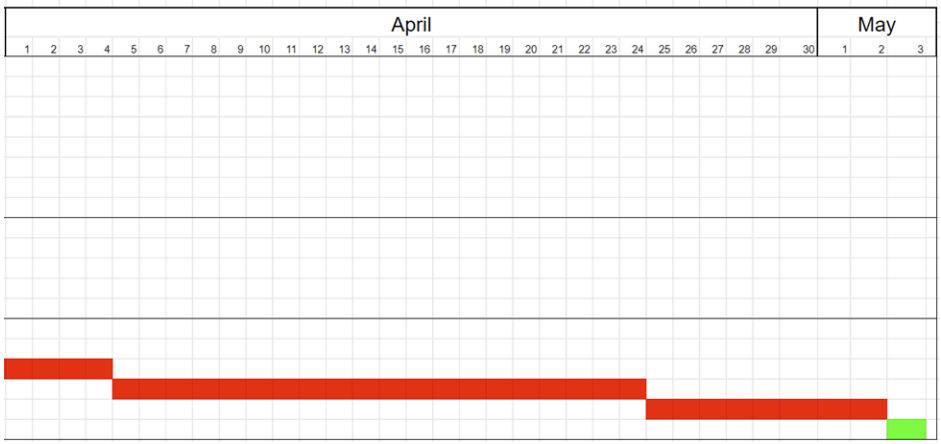


Table shows the Gantt Chart from the Spring Project Plan section

List of Figures

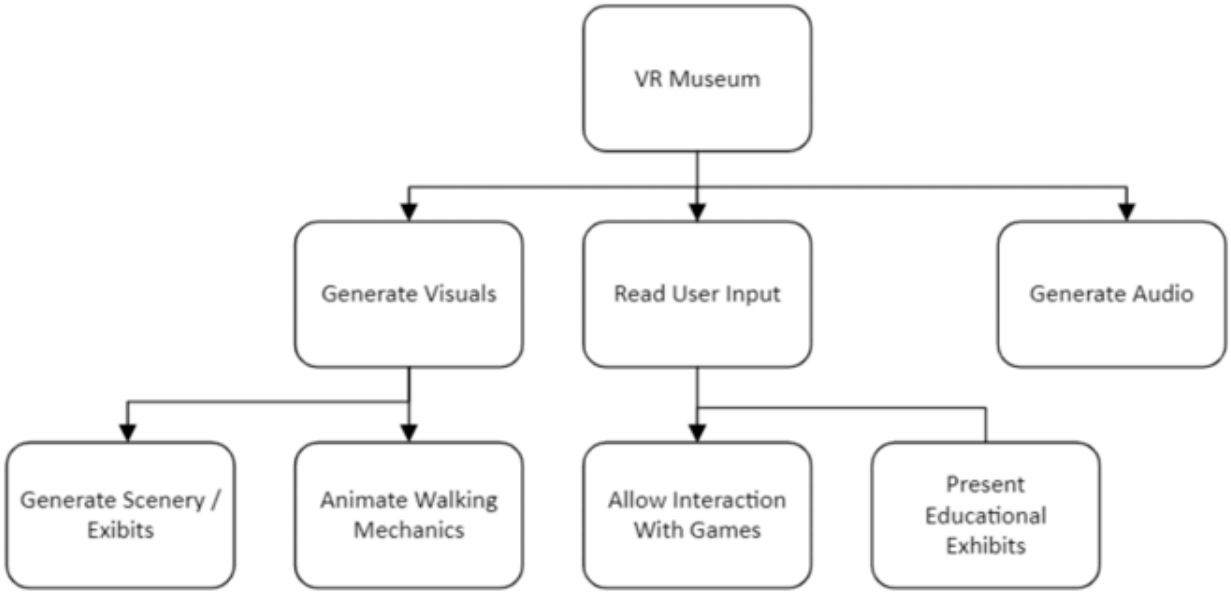
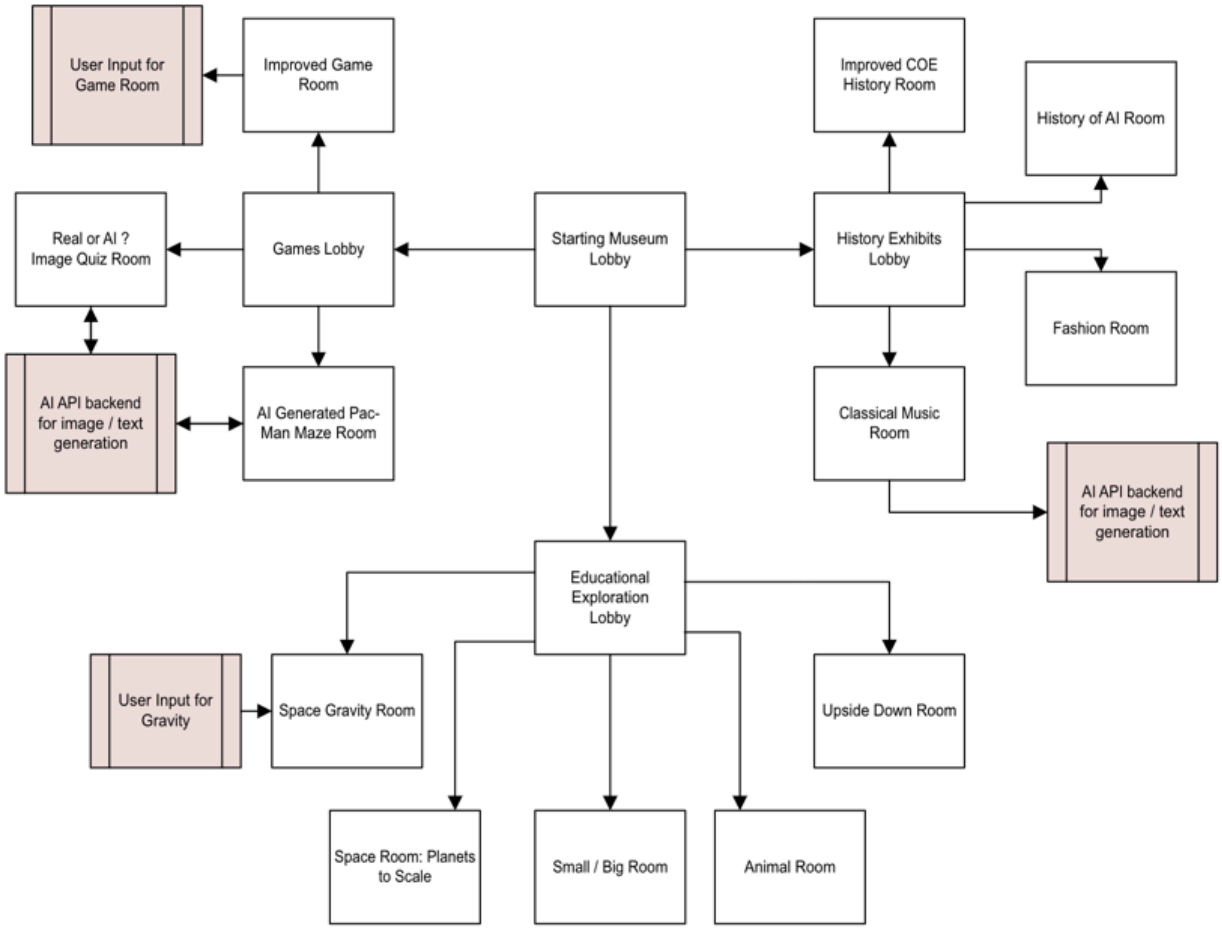


Figure shows the function tree from the Functional Decomposition section



Figures show the preliminary design of the Museum

Notation

AI	Artificial Intelligence
API	Application Programming Interface
COE	College of Engineering
IEEE	Institute of Electrical and Electronics Engineers
STEM	Science, Technology, Engineering, and Math
UI	User Interface
VR	Virtual Reality

Chapter One: EEL 4914C/4915C

1.1 Project Scope

Generative AI Virtual Reality FAMU-FSU CoE Museum

- Description: A virtual reality museum designed to captivate and educate students and AI/VR enthusiasts alike. Utilizing the cutting-edge Google Metaquest 3 and advanced AI technology, this experience explores a wide range of historical and cultural topics. Our Our goal is to ignite a passion for art within the STEM field, inspiring students to appreciate the intersection of technology and creativity. Through engaging exhibits and interactive elements, participants will embark on a journey that blends entertainment with education, fostering a deeper understanding of our shared heritage.

- Goal: Educate students about the inclusion of art in the STEM field in an immersive environment and encourage passion about historical/cultural topics. The group will add more exhibits and features to increase immersion. The museum will help educate consumers about the future development of AI and VR and their incorporation in numerous fields such as video games and art.

- Personal Goals: All students involved in the group have displayed an interest in both Virtual Reality and Artificial Intelligence. These fields are continuing to grow at a rapid rate and will likely be incorporated in many areas that the group members are passionate about, such as video games. All group members are interested in developing their software developing skills, and this project will provide them an opportunity to develop these skills in programming languages that they might not have much experience in, such as C# and Python. These goals will help assist students in pursuing the overall goal of the project, since completing the project effectively will help in all these.

- Primary market: Engineering Students/Educators
- Secondary market: Younger students interested in the arts/sciences
- Tertiary market: Virtual Reality enthusiasts

- Assumptions: AI will be used to generate parts of exhibits, VR will be the medium for use
- Stakeholders: Google/COE, Dr. Bernadin, Dr. Migara, Dr. Chuy, Dr. Hooker

1.2 Customer Needs

Introduction:

The Artificial Intelligence Virtual Reality Museum is a senior design project developed for the FAMU-FSU College of Engineering. We aim to create a virtual museum experience that blends the arts and the sciences, showcasing exhibits encompassing both concepts. Virtual Reality shall provide an immersive viewing experience, and with the use of Artificial Intelligence, we can also add interactivity. The project aims to educate, entertain, and inspire students, faculty, and anyone else about the inclusion of the arts in STEM and AI across various disciplines.

The customer statements and needs shown were determined by meeting with Dr. Migara and discussing the sponsor's goals for the project. The needs and requirements were fairly open-ended and left to the group's discretion. When asked what the finished product is expected to look like, Dr. Migara stated that he and Dr. Bernadin wanted the VR Museum to utilize more AI-related components and include more interactivity in the exhibits. It was also mentioned that adding more exhibits to the Museum would be ideal. The hardware that shall be used in the production of the Museum was mentioned, which shall be the Metaquest 3 and the computer in the Machine Learning Lab. Dr. Migara also mentioned some issues in the current Museum, including some clipping errors that should be resolved.

No.	NEED/ STATEMENT	SOURCE
1	Need to involve Artificial Intelligence.	Customer
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3	Needs to be interactive.	Customer
4	Needs to display historical and artistic exhibits.	Customer

	NEED	REQUIREMENT/ INTERPRETATION
1	1	AI shall help create and modify the exhibits.
2	1	The exhibits shall be designed for an immersive VR experience.
3	2	Shall have exhibits that change or play audio when users interact with them; shall implement voiced characters to interact with.
4	3	Visitors shall explore rooms dedicated to classical music, paintings, and sculptures, bringing the museum to life in an interactive 3D space.

Codes and Standards:

Will conform to **Copyright Laws Of the United States (Title 17)** when using image/sound generating AI.

IEEE 7010-2020: IEEE Recommended Practice for Assessing the Impact of Autonomous and Intelligent Systems on Human Well-Being.

IEEE 3079: A standard that aims to reduce cybersickness in VR by providing technical guidance to developers, manufacturers, and service providers.

Summary:

Through meeting with Dr. Migara, we were able to get all of these needs and interpret them into requirements. The use of Artificial Intelligence in this project is a pillar, and using it to help create and modify the exhibits is crucial to the educational and entertainment factor. This gives the team freedom to experiment with different forms of AI interactivity, and shall be a major focus throughout the project. Another pillar of the project is that it shall be showcased in virtual reality, this is a more recently developed area in game and program development, and incites curiosity and excitement in consumers. Focusing on AI and VR makes this project a wonderful blend of two new interesting pieces of technology, which makes showcasing the arts and sciences that much more interesting for new and interested consumers. The interactive audio requirement shall be important for the immersion of the museum, bringing the environment to life

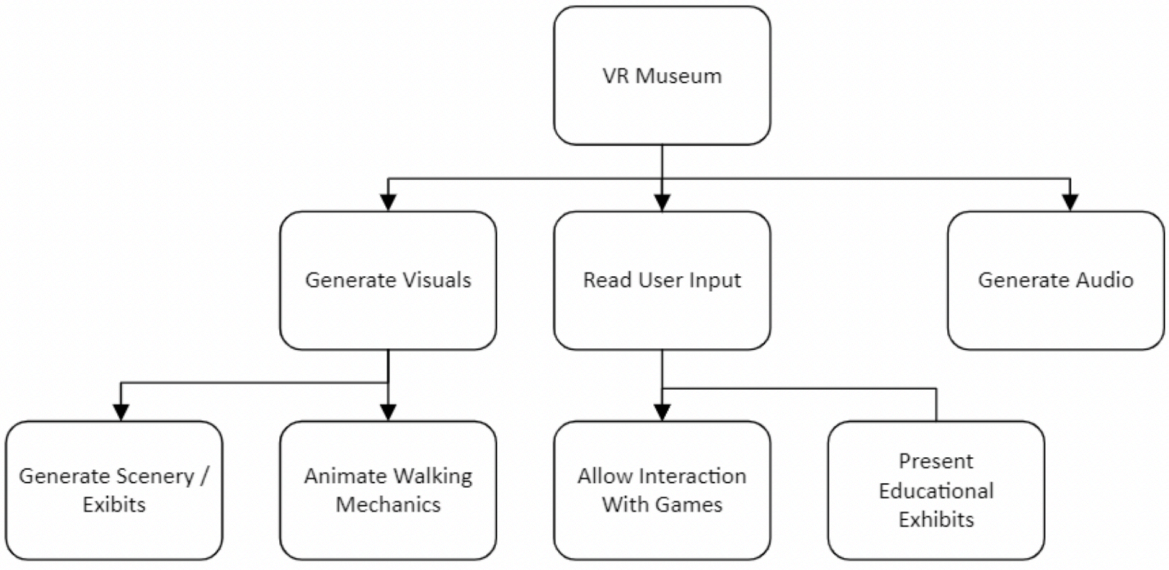
with voiced characters that can be implemented with AI backends and 3D models and animations. The final requirement mentions the different rooms in the museum, where players shall be able to learn and experience over a multitude of different fields and interests. One of this museum project's biggest goals is to showcase how intertwined the arts are with the sciences, and with the variety of exhibits we plan to add, there shall be something to discover for every visitor.

1.3 Functional Decomposition

Introduction

This document outlines the functional decomposition of a VR Museum aimed at delivering an immersive and interactive experience for visitors. By utilizing tools like generative AI, spatial audio, and interactive games, the museum offers an engaging way for users to explore educational content. The function tree and table break down the major components and show how VR and AI elements collaborate to create a cohesive experience that meets user needs.

Function Tree



Cross Reference Table

Minor Functions	Major Functions				
		Generate Audio	Read User Input	Generate Visuals	Customer Needs
	Generative Scenery	-	-	x	1,2
	Animated walking mechanics	-	-	x	2
	Allow interaction with games	-	x	-	1,2,3
	Present educational exhibits	-	x	-	2,4

Modules input, output and description of the functional behavior

Level 1:

Module	VR Museum
Inputs	Blender, unity
Outputs	3-D VR environment
Functionality	Create a VR environment of an educational/artistic museum for users to explore

Level 2:

Module	Generate Visuals
Inputs	Generative AI, Unity, Blender
Outputs	Generative exhibits, animations, VR display
Functionality	Create immersion for users to feel more involved in the museum

Module	Read User Input
Inputs	Unity, C#, VR controller
Outputs	Playable games, educational exhibits
Functionality	Create exhibits that users can interact with through VR for a more entertaining experience

Module	Generate Audio
Inputs	Voice, Speech-to-text AI
Outputs	AI generated images, AI-generated voices/audio
Functionality	Incorporate generative AI so users can gain a better understanding of the use of AI in numerous functions

Level 3:

Module	Generative scenery/exhibits
Inputs	AI
Outputs	AI generated maze, AI generated images, AI generated audio
Functionality	Create exhibits that are unique for each individual to demonstrate AI-generative capabilities

Module	Walking animations
Inputs	Blender/3D modeling
Outputs	Animations and movement in Unity
Functionality	Develop a more immersive experience by providing movement mechanics

Module	Playable games
Inputs	C#, Python, Blender, Unity, VR controller
Outputs	First-person Pacman, Connect-4, etc.
Functionality	Provide users with a more interactive experience by having games in certain exhibits

Module	Educational exhibits
Inputs	Blender, Unity
Outputs	Artistic and historical displays
Functionality	Give users an educational experience within the museum

Summary

The VR Museum is divided into several key modules: generate visuals, read user input, and generate audio. Each module, developed using tools like Unity and Blender, plays a role in creating a rich and dynamic environment. By integrating these elements, the project creates a space where users can not only learn but also interact and enjoy the exhibits in a unique virtual setting. Some modules that are planned to be included are playable games such as an AI-generated maze, a connect-4 game where users can compete against an AI player, and multiple exhibits that utilize AI to cater the experience to each user. Numerous exhibits will include AI-generated art so that users can gain a better understanding of how AI can be incorporated into various types of projects in the future.

1.4 Target Summary

Functions:

1. Virtual Reality
    a. Targets
        i. Maintain smooth VR experience at a >72 FPS framerate
        ii. Ensure a 1080x1200 resolution per eye for VR headset
    b. Metrics
        i. Use Unity's profiler to monitor framerate and make necessary adjustments to maintain consistent performance
        ii. Test multiple VR headsets for compatibility with resolution
2. Artificial Intelligence
    a. Targets
        i. Achieve a 90% accuracy rate in object recognition and interaction within the VR environment.
        ii. Reduce response time for AI interactions to under 2 seconds.
    b. Metrics
        i. Number of successful interactions vs. total interactions.
        ii. Average response time for AI-generated responses
3. Customer Needs
    a. Targets
        i. 80% of users are satisfied and spend at least 10 minutes exploring the museum
    b. Metrics
        i. Conduct surveys after user test experience, and time throughout testing
4. Immersion
    a. Targets
        i. Achieve a minimum immersion score of 4 out of 5 in user feedback.
        ii. Ensure at least 1 different interactive experiences per exhibit.
    b. Metrics
        i. User feedback scores on immersion collected through surveys.
        ii. Number of unique interactions performed by users.

5. Interactivity
    a. Targets
        i. Ensure at least 1 different interactive element per exhibit.
        ii. Ensure 75% of users engage with at least 1 interactive element per exhibit.
    b. Metrics
        i. Monitor interactions through Unity, tracking interactive engagements
        ii. Number of unique interactions performed by users
6. Artistic Expression
    a. Targets
        i. Showcase at least 3 different artistic styles or mediums within the museum.
        ii. Ensure a minimum rating of at least 4/5 for artistic quality in user surveys
    b. Metrics
        i. User ratings of artistic elements collected through surveys
        ii. Number of artworks or styles presented in the VR experience

Summary

In this document, the targets and metrics of the project were discussed. The most important functions of this project relate to the use of Virtual Reality and Artificial Intelligence, as those were the two most important of the needs and requirements. The targets and metrics were determined using the needs and requirements list derived by meeting with the sponsor of the project. After the project is complete, the VR Museum will be simulated by the group and a few more students to ensure that these targets were met. The use of VR and AI are by far the most critical of these targets, and the metrics by which these will be tested are listed above. Immersion, interactivity, and the customer needs targets are more open-ended and will require testing by other students and a survey will be provided to obtain feedback. The FPS and resolution can easily be measured via Unity, and the surveys will help obtain the information on the other targets.

1.5 Concept Generation

Introduction

The following document outlines the concept generation phase of the AI VR museum project. This museum aims to merge cutting-edge technologies with immersive experiences, allowing users to explore dynamically evolving exhibits shaped by AI. To achieve this vision, 100 unique concepts were systematically generated by evaluating the core functions and objectives of the project. These functions include immersive education, artistic expression, AI-driven content creation, and user interactivity. By analyzing these aspects, the concepts address various design challenges and opportunities, such as how AI can create adaptive exhibits, enhance learning outcomes, and personalize the user experience. The generated concepts span a diverse range of possibilities, from AI-curated art galleries to interactive educational simulations and community-driven virtual installations. This section details the concept generation process, highlighting the interdisciplinary approaches used to brainstorm and refine ideas that align with the project's goals.

Concept Generation Approaches

VR	Metaquest 3	Apple Vision Pro	Metquest Pro	Oculus	Playstation VR
AI	Incorporate multiple AI tools: ChatGPT, Suno, MidJourney	ChatGPT	Suno	MidJourney	Elevenlabs
Modeling	Animations/models in Blender	Use Maya for models	Use CAD for models	Use Sketchup for models	Use Cinema4D for renders
Interactivity	Include numerous types of interaction: games, spatial audio, generative exhibits	Add interactive games	Add interactive elements to existing exhibits	Spatial audio	Image generation
Artistic Expression	Add a variety of artistic forms	Focus more on painting/imagery	Focus on historical exhibits	Add musical expression	Add dancing/ expressive art exhibits
Engine	Unreal Engine	Unity	Godot	Lumberyard	CRYENGINE

The chart above outlines a morphological analysis of our project to come up with our 100 concepts. The morphological analysis consists of analyzing the different functions of our project and determining multiple different solutions that address each function. These potential solutions aim to address the technological and experiential requirements of the project.

1. Virtual Reality (VR) Platforms

The chart lists several VR platforms, including MetaQuest 3, Apple Vision Pro, MetaQuest Pro, Oculus, and PlayStation VR. These platforms offer varying levels of accessibility, hardware performance, and user experience. MetaQuest devices, for instance, are known for their standalone functionality and broad audience reach, while Apple Vision Pro offers high-end capabilities with cutting-edge mixed-reality features. The choice of platform will depend on factors such as target audience, budget, and desired interactivity level.

2. Artificial Intelligence (AI) Tools

AI tools like ChatGPT, Suno, MidJourney, and ElevenLabs are included for their unique capabilities. For example, ChatGPT could be employed to generate dynamic, conversational exhibits, while MidJourney provides generative AI for visual content creation. Suno and ElevenLabs could support audio-related features, such as voiceovers or soundscapes. The inclusion of multiple AI tools highlights the interdisciplinary approach needed to craft an immersive and adaptive virtual museum.

3. 3D Modeling and Animation Tools

The modeling aspect considers tools such as Blender, Maya, CAD, SketchUp, and Cinema4D. Blender and Maya are suited for creating animations and intricate 3D assets, while CAD and SketchUp might be better suited for architectural elements and exhibit layouts. Cinema4D's rendering capabilities can enhance the visual fidelity of the exhibits, adding to the overall realism and artistic appeal.

4. Interactivity Features

Interactivity is a key component for engagement. The chart proposes a variety of options, including interactive games, generative exhibits, spatial audio, and image generation. Spatial audio can deepen immersion by providing directional sound cues, while interactive games encourage active participation. Image generation could personalize exhibits, tailoring the experience for individual users. This variety ensures a broad spectrum of interactive options to cater to diverse user preferences.

5. Artistic Expression

Artistic expression is categorized into multiple forms, such as painting, imagery, music, historical themes, and expressive art like dance. These categories reflect the museum's goal to provide diverse cultural and educational experiences. For instance, focusing on historical exhibits could educate visitors on important events, while musical or dancing exhibits could create immersive performances that bridge art and technology.

6. Game Engines

The chart lists Unreal Engine, Unity, Godot, Lumberyard, and CRYENGINE as potential engines. Unreal Engine and Unity are industry leaders, known for their powerful VR and AI integration capabilities. Godot offers an open-source alternative for budget-conscious projects, while Lumberyard and CRYENGINE provide options for high-performance and visually stunning experiences. The engine choice will significantly impact the project's development workflow and final experience.

Using the different solutions from the above morphological analysis, we were able to come up with a variety of different concepts. Our high-fidelity concepts will incorporate solutions to all the different functions, since the high-fidelity concepts should have all the information we need to complete the project. Each high-fidelity concept will be slightly different by mixing different solutions into one concept. For example, one high-fidelity concept will use the Metaquest for the VR headset, ChatGPT for the AI tool, and Blender for 3D modeling. Another high-fidelity concept will use the Apple Vision Pro instead. Interactivity and artistic expression are much more broad functions, so all the different concepts could not be listed in the morphological chart. These concepts were still related to the morphological analysis since they were created by addressing those two functions.

Another approach to concept generation we used was crapshoot, where each member randomly came up with ideas and wrote them down so that our group could discuss each one and consider which ones should be incorporated in our concept generation. This specific method works well for our project since it is more creativity oriented. Things like interactivity and artistic expression would be better addressed with crapshoot, for example. After the group discussed each concept they were either discarded or placed in the concept generation list.

High Fidelity Concepts:

1. Game engine: Unity
   3D Modeling: Blender
   AI: use a variety of tools such as ChatGPT, Midjourney, and Suno
   VR Headset: Metaquest 3
   Interactivity: include various types of interactivity such as spatial audio, playable games, and generative exhibits
   Artistic Expression: include a variety of different types of exhibits such as a sports room, history of AI room, film room, and improved game room.
2. Game engine: Unreal Engine
   3D Modeling: Blender
   AI: use various AI generation tools such as ChatGPT, Midjourney, and Suno
   VR Headset: Metaquest 3
   Interactivity: include various types of interactivity such as spatial audio games, and generative exhibits
   Artistic Expression: include a variety of different types of exhibits such as a sports room, history of AI room, and film room.
3. Game Engine: Godot
   3D Modeling: Blender
   AI: use Suno for AI generation
   VR Headset: Apple Vision Pro
   Interactivity: include various types of interactivity such as spatial audio and playable games.
   Artistic Expression: include a variety of different types of exhibits such as a sports room, history of AI room, and film room.
4. Game Engine: Unity
   3D Modeling: Blender
   AI: use numerous types of AI such as ChatGPT, Suno, and MidJourney
   VR Headset: Apple Vision Pro
   Interactivity: include various types of interactivity such as spatial audio, playable games, and generative exhibits
   Artistic Expression: Include a variety of different types of exhibits such as a sports room, history of AI room, and film room.

Medium Fidelity Concepts

1. Use Unity as a game engine and Blender for 3D modeling, use various generative AI tools, include various art forms
2. Use Unity as a game engine and Blender for modeling, use a headset other than the Metaquest 3 and use various types of AI
3. Use Unreal Engine as a game engine and Blender for modeling, use a headset other than the Metaquest 3 and use various types of AI
4. Use Unreal Engine as a game engine and Blender for 3D modeling, use various generative AI tools, include various art forms
5. Use the Apple Vision Pro for the headset and use various types of generative AI, focus on historical exhibits such as history of AI
6. Use the Metaquest 3 for the headset and use ChatGPT for AI implementation, add exhibits relating to sports, AI, and film
7. Use Unreal Engine as a game engine and Blender for modeling, use the Metaquest 3, create artistic and historical exhibits.

1	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Metaquest 3 for VR headset
2	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Metaquest 3 for VR headset
3	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Metaquest 3 for VR headset
4	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Metaquest 3 for VR headset
5	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Apple Vision Pro for VR headset
6	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Apple Vision Pro for VR headset
7	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use MidJourney for AI generation, use Apple Vision Pro for VR headset
8	10/23/2024	Use Ureal Engine as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Apple Vision Pro for VR headset
9	10/23/2024	Use Unity as a game engine and Blender for 3D modelling/animations to create the base of the museum, use ChatGPT for AI generation, use Metaquest 3 for VR headset
10	10/23/2024	Playstation VR used for VR headset
11	10/23/2024	Use Unity as a game engine and Blender for 3D modeling, use various generative AI tools, include various art forms
12	10/23/2024	Use an Oculus for the VR implementation
13	10/23/2024	Samsung HMD Odyssey
14	10/24/2024	Use Google Metaquest 3 for VR
15	10/24/2024	Use ChatGPT as AI tool
16	10/24/2024	Use Unreal Engine as a game engine and Blender for modeling, use the Metaquest 3, create artistic and historical exhibits
17	10/24/2024	Use Unity and Blender for modelling/animations, use the Metaquest 3 for the VR headset, include numerous generative AI tools such as ChatGPT, Midjourney, and Suno
18	10/24/2024	Use Suno for generative music and audio
19	10/24/2024	Use Google Gemini for generative AI
20	10/24/2024	Use ChatGPT for AI, use some other game engine
21	10/24/2024	Find another 3D modelling tool other than Blender
22	10/24/2024	Use other game and modelling engines than the ones provided, use a headset other than the Metaquest
23	10/24/2024	Use Unreal Engine as a game engine and Blender for modeling, use a headset other than the Metaquest 3 and use various types of AI
24	10/24/2024	Small Room: All models are small, making player feel big
25	10/24/2024	Space Room: Show planets and sun to scale
26	10/24/2024	VR Meteor Shower in space room
27	10/24/2024	Balloon Gun: Inflate balloons with trigger, let go and they float
28	10/24/2024	Upside-Down Room: Inverted Gravity Room
29	10/24/2024	Black Hole Simulator: In space room
30	10/24/2024	AI design a planet: AI generated planet images based off user input
31	10/24/2024	Climbable DNA Helix: Genetics exhibit
32	10/24/2024	Bug Room: Shrink down and look at bugs / bug POV
33	10/24/2024	Animal Room: Miniature Zoo, AI generated animals?
34	10/24/2024	Painting Room: Paint on a canvas, AI generates an alternate version?
35	10/24/2024	Space Station Room: Feel like you're on a spaceship with zero gravity
36	10/24/2024	Ocean Exploration Room: Fish and reefs, feels like you're underwater
37	10/24/2024	VR Roller Coaster: goes throughout the museum
38	10/24/2024	Interactive Volcano Room: goes off at random times
39	10/24/2024	Timed Museum Events: event happen around the museum and are announced for visitors to find
40	10/24/2024	Use Unreal Engine as a game engine and Blender for 3D modeling, use various generative AI tools, include various art forms
41	10/24/2024	AI or Real? Quiz with AI images if they are real/from an artist or AI
42	10/24/2024	Experimental Gravity room: Change gravity with a lever that users can control
43	10/24/2024	AI Music Room : Music Generated by AI
44	10/24/2024	AI Art Generator Gallery: Create real time AI-generated art
45	10/24/2024	AI-Powered Language Translator Room: Translate speech with AI in real time
46	10/24/2024	VR Escape Room: Solve puzzles related to exhibits to escape a themed room.
47	10/24/2024	AI History Quiz Game: Participate in AI-generated quizzes about exhibits for rewards.
48	10/24/2024	AI Biodiversity Exploration: Explore ecosystems and endangered species with AI simulations.
49	10/24/2024	Museum Detective with AI: Solve art thefts or historical mysteries using AI-generated clues.
50	10/24/2024	Game of Inventions by AI: Explore groundbreaking inventions with AI-enhanced storytelling.
51	10/24/2024	Sports history room with interactive sports
52	10/24/2024	Fantasy Exhibit: Explore a whimsical museum with mythical and fantastical elements.
53	10/24/2024	Literature room - history of literature and AI generated images
54	10/24/2024	Olympics room - history of olympics back to Greece
55	10/24/2024	AI Sculpting: Create and manipulate sculptures using AI design tools.
56	10/24/2024	Interactive basketball hoop and ball

57	10/24/2024	Interactive avatars of historical artists
58	10/24/2024	Photo Challenge: Capture virtual "photographs" of specific exhibits or artifacts.
59	10/24/2024	Artifact Discovery with AI: A scavenger hunt guided by AI clues to find hidden artifacts.
60	10/24/2024	Architectural Analysis by AI: Explore famous buildings with AI-generated insights on design and history.
61	10/24/2024	Time-travel mechanics to investigate historical context
62	10/24/2024	VR Meditation Space: Experience calming virtual environments tied to cultural practices.
63	10/24/2024	AI generated alternate history of art
64	10/24/2024	Art Critique by AI: Engage in discussions about artworks with AI-generated critiques.
65	10/24/2024	AI Storytelling Paths: Choose your own adventure as narratives unfold based on AI algorithms.
66	10/24/2024	AI Generated Maze Exhbit: Find your way through procedurally generated mazes.
67	10/24/2024	AI Mythology Adventures: Learn about different mythologies through AI-enhanced storytelling.
68	10/24/2024	Seasonal AI Events: Engage in seasonal activities with AI-generated themes from various cultures.
69	10/24/2024	AI Character Creation: Design historical figures with AI, altering their attributes and stories.
70	10/24/2024	AI Language Translation: Explore exhibits in multiple languages with real-time AI translation.
71	10/24/2024	VR Research Lab: Conduct virtual experiments with AI analyzing outcomes and data.
72	10/24/2024	Historical Scenario Simulations: Participate in AI-driven simulations of pivotal historical moments
73	10/24/2024	Cultural Cuisine Experience: Cook virtual meals with AI guidance based on historical recipes.
74	10/24/2024	Artifact Reconstruction: Use AI to visualize how ancient artifacts were originally used.
75	10/24/2024	Use Elevenlabs for AI implementation
76	10/24/2024	Crisis Simulation Games: Engage in AI simulations that place you in historical crises to understand decision-making.
77	10/24/2024	AI Historical Timeline: Create dynamic timelines that adapt based on user choices and interactions.
78	10/24/2024	Customized Learning Paths: Follow AI-curated educational paths based on personal interests and knowledge levels.
79	10/24/2024	Interactive Historical Maps: Explore AI-generated maps that reveal hidden stories behind locations
80	10/24/2024	AI Museum Trivia Night: Participate in a trivia game where AI generates questions based on exhibits.
81	10/24/2024	AI Reflection Rooms: Experience meditative spaces that use AI to adapt to your mood.
82	10/24/2024	AI Ethics Workshop: Participate in discussions on the ethical implications of AI in society.
83	10/24/2024	Creative Writing Prompts: Receive AI-generated prompts inspired by exhibits for creative writing.
84	10/24/2024	Virtual AI Gardening: Cultivate virtual gardens inspired by historical botany using AI guidance.
85	10/24/2024	Personalized Exhibit Recommendations: AI suggests exhibits based on visitor interests and preferences.
86	10/24/2024	AI Voiceovers for Artworks: Listen to AI-generated audio guides that provide insights about specific pieces.
87	10/24/2024	Virtual AI Historical Debate Club: Engage in debates on historical topics, moderated by AI.
88	10/24/2024	AI-Enhanced Cultural Dialogues: Participate in AI-facilitated discussions about cultural understanding and history.
89	10/24/2024	AI-Generated Soundscapes: Create personalized soundscapes that reflect your experience within the museum.
90	10/24/2024	Virtual Reality Language Labs: Practice languages with AI characters in immersive settings related to cultural exhibits.
91	10/24/2024	AI-Powered Music Experiences: Explore music history with AI creating playlists that reflect historical eras.
92	10/24/2024	Virtual Reality Treasure Hunts: Use AI clues to uncover hidden treasures in themed museum exhibits.
93	10/24/2024	AI-Generated Documentary Experiences: Participate in interactive documentaries that blend storytelling and education.
94	10/24/2024	Virtual Reality Reenactments: Experience and participate in reenactments of historical events guided by AI.
95	10/24/2024	AI-Powered Personal Journals: Keep a virtual journal of your experiences, with AI providing insights and reflections.
96	10/24/2024	AI Language Evolution Exhibit: Explore how languages have evolved using AI-generated linguistic data.
97	10/24/2024	Interactive Environmental History: Explore the impact of humans on the environment through AI-driven simulations.
98	10/24/2024	Digital Reconstruction of Historical Sites: Explore AI-generated reconstructions of significant historical locations.
99	10/24/2024	Virtual Reality Cross-Cultural Collaborations: Engage in projects that merge different cultural perspectives through AI.
100	10/24/2024	Interactive Philosophy Workshops: Explore philosophical questions through AI-facilitated discussions related to historical events.

Concept 1.

Game engine: Unity
3D Modeling: Blender
AI: use a variety of tools such as ChatGPT, Midjourney, and Suno
VR Headset: Metaquest 3
Interactivity: include various types of interactivity such as spatial audio, playable games, and generative exhibits.

Concept 2.

Game engine: Unreal Engine
3D Modeling: Blender
AI: use various AI generation tools such as ChatGPT, Midjourney, and Suno
VR Headset: Metaquest 3
Interactivity: include various types of interactivity such as spatial audio games, and generative exhibits
Artistic Expression: include a variety of different types of exhibits such as a sports room, history of AI room, and film room.

Concept 3.

Game Engine: Godot
3D Modeling: Blender
AI: use Suno for AI generation
VR Headset: Apple Vision Pro
Interactivity: include various types of interactivity such as spatial audio and playable games.
Artistic Expression: include a variety of different types of exhibits such as a sports room, history of AI room, and film room.

Concept 4.

Game Engine: Unity
3D Modeling: Blender
AI: use numerous types of AI such as ChatGPT, Suno, and MidJourney
VR Headset: Apple Vision Pro
Interactivity: include various types of interactivity such as spatial audio, playable games, and generative exhibits
Artistic Expression: Include a variety of different types of exhibits such as a sports room, history of AI room, and film room.

Summary

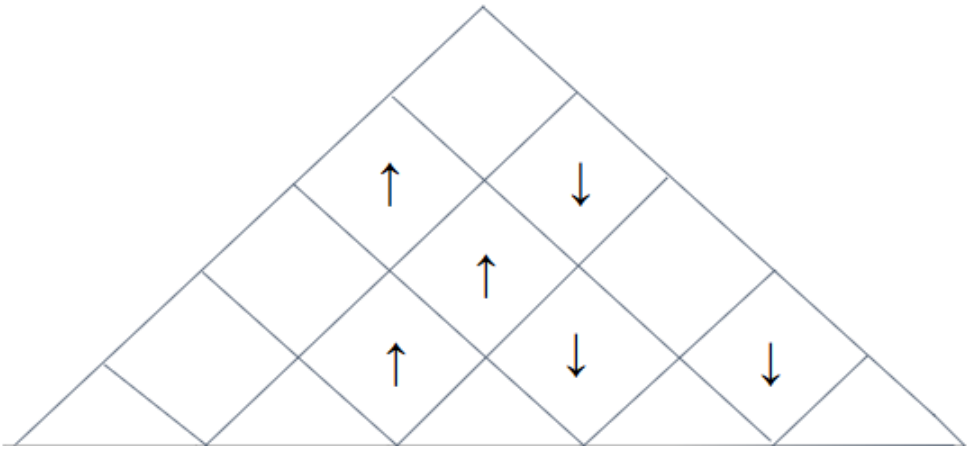
The concept generation process for the AI VR Museum is listed above. It consists of 100 concepts that address either all the functions of the project or smaller components of the project. These concepts were derived through a structured approach by analyzing and addressing the various functional requirements of the project. The project aims to leverage AI for dynamic exhibit creation and modification, ensuring an immersive, interactive, and educational experience for users. The morphological analysis identified key areas such as content generation, user engagement, and exhibit variety, which guided the brainstorming process. From the pool of 100 concepts, four high-fidelity concepts were refined to provide comprehensive solutions, addressing every functional aspect in detail. These high-fidelity concepts represented well-rounded approaches with defined strategies for all the functions listed such as use of AI, VR, interactivity, and artistic expression. They form the basis for evaluating feasibility and further development in subsequent project stages.

1.6 Concept Selection

Introduction

The concept selection phase of the project is outlined in this document. This phase focuses on systematically evaluating the concepts generated during the earlier stages to determine a final concept that aligns with the project's objectives and functional requirements. To ensure a thorough and objective decision-making process, a combination of House of Quality, Analytical Hierarchy Process, and Pugh Chart methodologies will be utilized. The House of Quality will establish the relationship between customer needs and technical specifications, ensuring the solution meets user expectations. The AHP will provide a structured framework for prioritizing criteria and comparing concepts based on weighted factors. Finally, the Pugh Chart will facilitate the comparison of alternatives by highlighting their relative strengths and weaknesses against a baseline concept. By integrating these methods, the concept selection process will ensure that the final design choice is robust, well-justified, and capable of delivering a dynamic, engaging, and educational VR museum experience.

House of Quality



		Efficient programming Language	High quality VR headset	3D Modeling	Smooth Experience	Cost
		+	+	+	+	-
Use of AI	+	↑			↓	↓
VR	+		↑↑	↑	↑	↓↓
Interactivity	+	↑↑	↑		↓	
Artistic Expression	+		↑	↑↑	↓	
Targets		Time between interactions and program ≤2 sec	Resolution of 1080x1200	User survey with 80% satisfaction	FPS >72	Budget of $500

Discussion

The chart listed above is the house of quality. The customer needs are listed on the left column of the chart and the engineering requirements to implement the project are listed on the top row. The roof of the house of quality indicates the interactions and correlation between our engineering requirements. The up arrows indicate that the requirements that meet at that intersection are directly correlated and the down arrow means they oppose one another. For example, an efficient programming language and a smooth experience will be directly correlated, since an efficient programming language will lead to a smooth user experience. Cost and VR headset are negatively correlated as indicated by the down arrow. This is because a high quality VR headset will be extremely expensive and the cost of the project should be as low as possible while still meeting our project targets.

The body of the House of Quality indicates interactions between the requirements and the needs. Most of the engineering requirements positively correlate with the customer needs, since the engineering requirements were derived from the customer needs. However, some engineering aspects will have problems collaborating with the needs, such as maintaining a smooth FPS. Using AI and incorporating interactive elements might make the VR experience more choppy or decrease the FPS since there will be some delay between user input and program output. The quality of the 3D models and the art on display will also affect the FPS, decreasing the smooth experience we are hoping for. Cost should not be a huge issue since all the hardware we need is already being provided but if a new VR headset is needed that will prove to be very expensive. Some AI generation tools might require a subscription as well, which will also be a factor in the cost of the project.

Pugh Chart

Concepts:

1. Use Unity as a game engine and Blender for 3D modeling/animations to create the base of the museum, use various AI generation tools such as ChatGPT, Midjourney, and Suno, use the Metaquest 3 as the VR headset, include various types of interactivity such as audio and games, and include a variety of different types of exhibits such as a sports room, history of AI room, film room, and improved game room.

2. Use Unreal Engine as a game engine and Blender for 3D modeling/animations to create the base of the museum, use various AI generation tools such as ChatGPT, Midjourney, and Suno, use the Metaquest 3 as the VR headset, include various types of interactivity such as audio and games, and include a variety of different types of exhibits such as a sports room, history of AI room, and film room.

3. Use Godot as a game engine and Blender for 3D modeling/animations, use Suno for AI generation, use the Apple Vision Pro as the VR headset, include various types of interactivity such as audio and games, and include a variety of different types of exhibits such as a sports room, history of AI room, and film room.

4. Use Unity as a game engine and Blender for 3D modeling/animations, use numerous types of AI such as ChatGPT, Suno, and MidJourney, use the Apple Vision Pro as the VR headset, include various types of interactivity such as audio and games, and include a variety of different types of exhibits such as a sports room, history of AI room, and film room.

		Concept 1	Concept 2	Concept 3	Concept 4
Use of AI	2	-	0	-1	0
VR Headset	3	-	0	-1	-1
Game Engine	5	-	-1	-1	0
3D modeling	1	-	0	0	0
Artistic Expression	2	-	0	0	0
Score		-	-1	-3	-1
Continue?		Yes	No	No	No

Discussion

The Pugh chart above compares our different high-fidelity-concepts function-by-function and decides which concept addresses that specific function in the best way. Concept 1 was chosen as our reference concept and the other three high-fidelity concepts will be compared to it. If the concept being compared to concept 1 does not address the correlating function as well as concept 1, then a point will be subtracted for that function. After each concept and function is assessed, the scores for each concept will be summed to determine which concept does the best job overall at addressing the functions.

Concept 2:

As shown above in the chart, Concept 2 received a zero for all functions except Game Engine. This is because Concept 1 and Concept 2 address all the other functions in the same way except for the game engine. Concept 2 has the same VR headset, same AI tools, and same ideas for artistic expression. Concept 1 utilizes the Unity game engine while Concept 2 utilizes the Unreal Engine. Concept 2 lost a point here because the Unity game engine is much more user-accessible than the Unreal Engine and is much more VR-compatible. For this specific application, the Unity game engine will allow us to implement the museum in VR much more easily and will be more user-friendly to a team that does not have much experience in game design.

Concept 3:

Concept 3 received a zero for 3D modeling and Artistic Expression because it addresses these functions in the same way as Concept 1. It lost points for AI, VR headset, and Game Engine, however. It lost a point for AI because concept 3 uses only Suno for its AI tools, which is not ideal compared to Concept 1, which uses a variety of AI tools. Certain AI tools are better at performing certain tasks, so using a variety of tools will be much better than simply deciding on using one. It lost a point for VR Headset because it proposes using the Apple Vision Pro as the headset compared to the Metaquest 3. The Metaquest 3 was considered to be the better option because the computer that will be used to program and run the museum will be a Windows PC rather than a Macbook because Windows is simply better at running games and 3D modeled atmospheres. Using the Apple Vision could lead to compatibility issues that might be unsolvable while the Metaquest 3 is designed specifically for Windows devices. It also lost a point for Game Engine, since it proposes using the Godot engine compared to the Unity engine. Unity was considered to be better for the same reasons listed above in the concept 2 discussion: more user-accessible, more VR compatibility, and much more development tools.

Concept 4:

Concept 4 received zeroes for all functions except VR Headset since it addresses these functions with the same solutions as concept 1. It lost a point for VR headset because it proposes using the Apple Vision Pro. It lost a point here for the same reasons listed above in the discussion of Concept 3's score.

From the score row for the concepts, each concept except Concept 1 ended with a negative score by adding the scores along each column. This means that Concept 1 was considered the best concept, which is why it was decided that this concept was the one we would be continuing with. This is because Concept 1 provides the best overall solution to all of the different functions the project needs to address. Unity is the most VR-compatible game engine and offers the best user-accessibility. A variety of AI tools is best because different AI tools are better at different things: Suno is great for generating audio and voices, MidJourney is great for generating images and scenery, and ChatGPT is best for miscellaneous uses such as text generation or exhibit descriptions. The Metaquest 3 is the best headset, in part because we already have a Metaquest 3 which will help save our budget and because it is the most compatible with Windows devices.

Analytical Hierarchy Process

Criterion	Weight	Concept 1	Concept 2	Concept 3	Concept 4
Use of AI	0.4	0.52	0.201	0.079	0.201
VR Headset	0.2	0.6	0.2	0.1	0.1
Game Engine Accessibility	0.15	0.7	0.1	0.1	0.1
3D Modeling	0.15	0.5	0.2	0.15	0.15
Artistic Expression	0.05	0.5	0.2	0.15	0.15
Total Score		0.558	0.1854	0.1041	0.1529

AHP Process

The following tables show the process of determining the scores for the AHP table listed above:

Pairwise comparison matrix for Use of AI

	Concept 1	Concept 2	Concept 3	Concept 4	Column Sum
Concept 1	1	3	5	3	12
Concept 2	1/3	1	4	2	7.33
Concept 3	1/5	1/4	1	1/3	1.783
Concept 4	1/3	1/2	3	1	4.833

Comparisons based on scales 1-9

1= equally important, 3 = moderate, 5= strong,

7= very strong, 9 = extreme

Normalize Matrix

	Concept 1	Concept 2	Concept 3	Concept 4
Concept 1	1/12 = **0.083**	3/7.333 =**0.409**	5/1.783 = **0.28**	3/ 4.833 = **0.621**
Concept 2	0.33/12 = **0.028**	1/7.33 = **0.136**	4/1.783 = **0.224**	2/ 4.833 = **0.069**
Concept 3	0.2/12 = **0.017**	0.25/7.33 = **0.034**	1/1.783 = **0.056**	0.33 / 4.833 = **0.069**
Concept 4	0.33/12 = **0.028**	0.5 / 7.333 = **0.068**	3/1.783 = **0.168**	1/ 4.833 = **0.207**

Calculate Row Averages

	Row Sum	Row Average
Concept 1	1.393	1.393/4 = 0.52
Concept 2	0.802	0.802/4 = 0.201
Concept 3	0.176	0.176 /4 = 0.079
Concept 4	0.802	0.802 / 4 = 0.201

Repeat process for each criterion

Total Score for Concept X = Sum (Weight of Criterion i × Weight of Concept X under Criterion i)

These tables go over the calculation of the scores for the use of AI criterion in the final AHP table. This process was used for all the other criteria as well.

Discussion

The AHP table made it easy to see which design would work best for our VR AI museum by breaking down the decision into our 5 key factors shown to the left of the AHP table. We assigned weight to each factor based on how important they are to the project, then rated each concept against these factors. **Concept 1** stood out with the highest score, thanks to its use of Unity and Blender, the Metaquest 3 headset, and a great mix of AI tools like ChatGPT, Midjourney, and Suno. It also includes a wide range of interactive exhibits that align perfectly with our goal of creating an accessible, engaging museum experience.

On the other hand, Concepts 2, 3 and 4 didn't score as high, mainly because they offered fewer exhibit options or had potential compatibility issues with certain hardware, like the Apple Vision Pro in Concept 3. Overall, the AHP table didn't just rank the options; it gave us a clear view of each concept's strengths and weaknesses, helping us choose Concept 1 as the best, most well-rounded choice for our project.

Final Selection:

Our final design selection after analyzing our high fidelity concepts is Concept 1. We will be implementing the COE Museum in the Unity game engine, because it is very user friendly and is extremely compatible with the use of VR headsets, unlike other game engines such as Unreal Engine. We will use Blender for 3D modeling and animations due to its versatility and the headset that we will be using is the Metaquest 3, since this is the headset that Dr. Bernadin has already provided for us and it meets our resolution requirements. We will incorporate various forms of AI generation so that we can have a wide variety of exhibits that use AI and we will add a few new rooms that have different artistic/historical content such as a history of AI room and a film room. This final decision was based on the charts we constructed above that consider the different functions and requirements of our project and rank the concepts based on their suitability. In the AHP for example, concept 1 had the highest score by far with 0.558, making it the optimal choice.

1.7 Preliminary Design

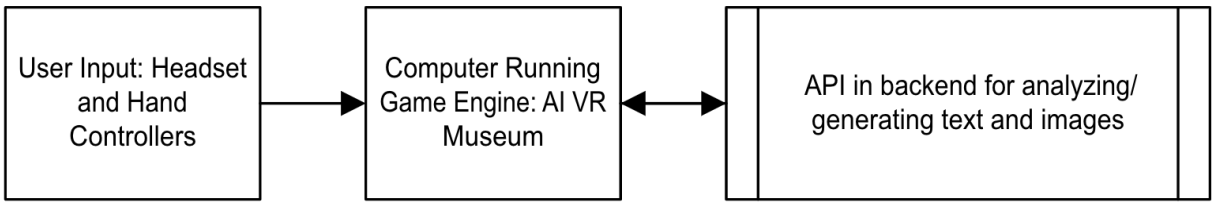
I. Introduction

This project, the AI VR COE Museum is a Virtual Reality Museum that will have a variety of artistic and educational exhibits. The purpose of the museum is to educate students about the inclusion of art in the STEM field in an immersive environment and encourage passion for historical/cultural topics. The museum will help educate consumers about the future development of AI and VR and their incorporation in numerous fields such as video games and art. The project is marketed towards engineering students and younger students who are interested in the arts/sciences, as well as VR enthusiasts in general. The sponsor, Dr. Bernadin, provided us with the following needs for the project: incorporate Artificial Intelligence, display the museum in VR, include interactive elements, and display artistic/historical exhibits. The requirements we derived from these needs are: AI shall help create and modify exhibits, exhibits shall be designed for an immersive experience, shall have exhibits that change or play audio when users interact with them, and visitors shall explore rooms dedicated to various types of arts or historical context. One of this museum project's biggest goals is to showcase how intertwined the arts are with the sciences, and with the variety of exhibits we plan to add, there shall be something to discover for every visitor.

II. Selected Concept

The final concept we selected implements the Unity game engine along with the Metaquest 3 as the VR headset. A foundation for this project already exists within the Unity game engine and we are already being provided Metaquest 3 headsets for VR implementation, providing a strong inclination to go with these options to minimize cost and for the sake of project continuity. Blender is our best option for 3D modeling as it is generally considered the most user friendly modeling tool, and using multiple AI generation tools is the best option since different AI tools excel at different things. We chose the concept because of Its advantages in AI integration, VR headset compatibility, and game engine accessibility that provide a solid foundation for developing an engaging and interactive experience. Since the museum already has a baseline, we plan on creating our own exhibits separately and adding them to the finished museum at a later date. Some of the exhibits we will create include a history of AI room, an improved game room, an improved COE history room, and a classical music room.

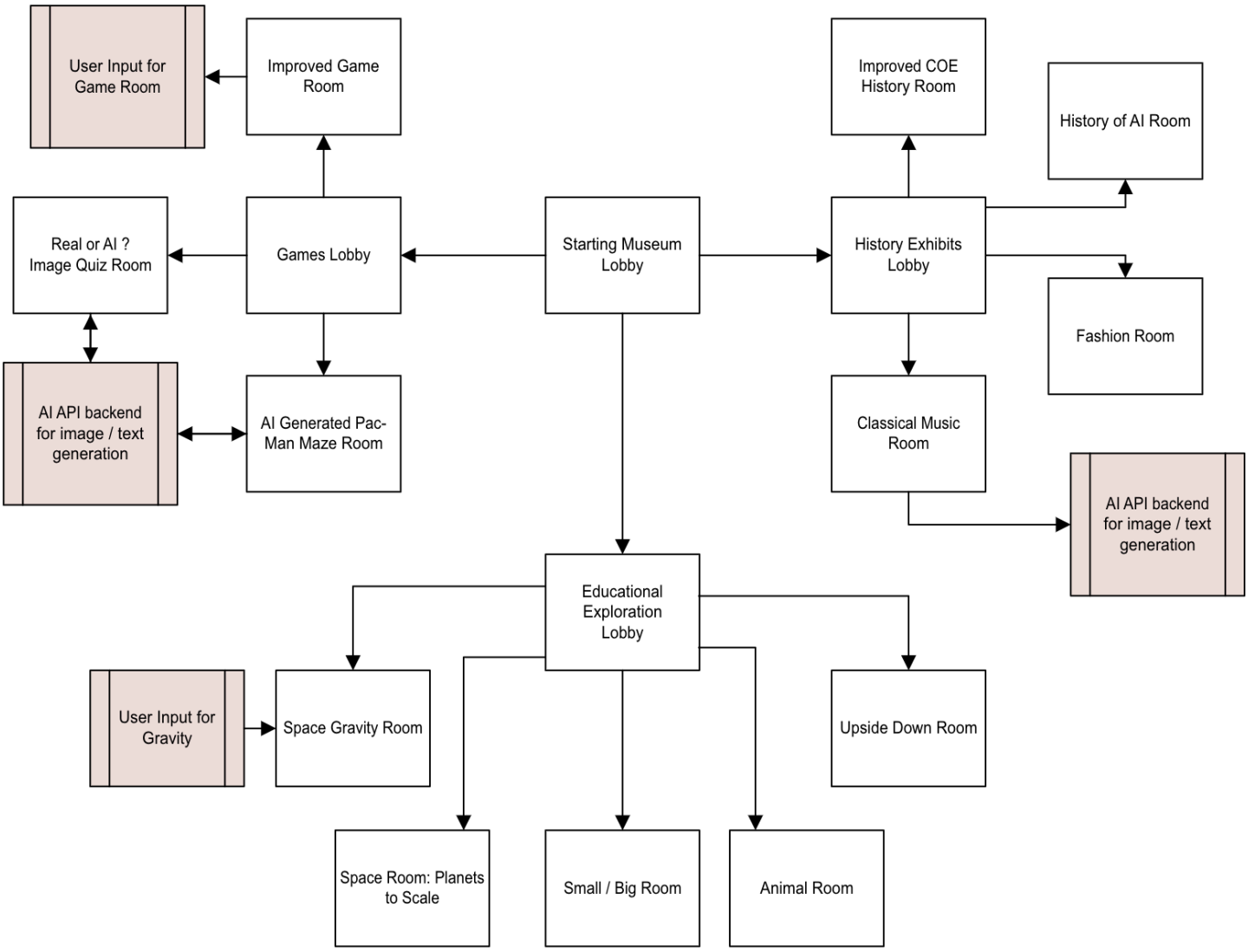
III. Preliminary Design



User Input: Headset and Hand Controllers
Options: Metaquest 3, Apple Vision Pro, Oculus, PSVR

Game Engine
Options: Unity, Unreal, Godot

API
Options: ChatGPT, MidJourney, Suno, Copilot, Google Cloud



Museum Layout - Red boxes indicate room subprocesses

Block 0 - Starting Museum Lobby : Will serve as the starting point of the user; encourages users to explore the wings of the museum.

Games Wing

- Block 1 - Improved Game Room : This section currently exists within our design. Improvements for this exhibit will be created to enhance immersion and interactivity such as adding motion to the pac man display and improved 3-D objects and animations.
- Block 2 - User Input for Game Room : Back end interfacing between the Metaquest headset and controller inputs from the user; supports block 1
- Block 3 - Games Lobby : The central room of the wing; designed to encourage exploration of the wing's exhibits
- Block 4 - Real or AI? Image Quiz Room : Users may explore this room and analyze several images too determine whether it was AI generated.
- Block 5 - AI API backend for image / text generation : The program that allows users to generate images and text for the quiz game; Supports the quiz game room and the maze room
- Block 6 - AI Generated Maze Room / Pac Man : Uses AI based procedural generation to generate explorable mazes. Also implements AI for behavior of NPCs. This exhibit may be separated into two rooms (Will be updated in the future).

History Wing

- Block 7 - History Exhibits Lobby : The starting point of the History Exhibits wing; designed to encourage exploration of the wing's exhibits.
- Block 8 - Improved COE History room : This exhibit currently exists, but can be improved by including more historical topics relating to the College of Engineering.

- Block 9 - History of AI Room : Will share similarities to the History of COE room, but will focus on the historical progression of AI development and applications.
- Block 10 - Fashion Room : This exhibit currently exists, but will be improved to include more 3-D fashion based objects and and fashion topics.
- Block 11 - Classical Music Room : Demonstrates the history of classical music while implementing AI generation for auditory and visual immersion.
- Block 12 - AI API backend for image / text generation : Will be used mostly for audio generation, but will have a similar application as the backend used within the Games wing.

Educational Exploration Wing

- Block 13 - Educational Exploration Lobby - The central room for the Educational Exploration wing; designed to encourage exploration of the wing's exhibits.
- Block 14 - Space Gravity Room : Will allow users to experience variations of gravitational pull. Will include inanimate objects in motion.
- Block 15 - User input for gravity : Will allow users to adjust gravity levels to be observed in the Space Gravity Room.
- Block 16 - Space Room: Planets to Scale : Will include a solar system with planets to scale for users to observe.
- Block 17 - Small / Big Room : Will allow users to explore environments where typical objects or settings are vastly larger or smaller that what is typically expected.
- Block 18 - Animal room : Will showcase several animal models that the users may observe, similar to a zoo.
- Block 19 - Upside Down Room: Will show a typical room setting with an inverted perspective.

IV. Summary

The preliminary design above outlines our plans for the development of the AI VR Museum. The most important components of this design are the use of AI, VR, and the incorporation of immersive interactive elements. The museum will serve an educational purpose and hopefully inspire interest in the collaboration of arts and the engineering fields. As shown above, it is important that we include exhibits that display a variety of art forms or historical content. This preliminary design was derived from our project requirements and the concept selection process, where we decided on the concept above. Using the Metquest 3 as a VR headset, users will provide input that will provide a variety of outputs in the form of audio and visual cues.

1.8 Spring Project Plan

Introduction

Our spring project plan outlines the key milestones and deliverables for completion of the FAMU-FSU College of Engineering VR AI Museum. Using a reverse planning approach, we were able to outline a timeline that details the critical tasks, when we plan for them to be done, while also noting important events like Engineering Design Day, In the Gantt Chart, the critical stages of Development and Testing were broken up into separate tasks that were given a start and end date to ensure we are effectively utilizing our time in the Spring semester. Final Exam Week, and Graduation. The accompanying Gantt chart shown below provides a visual representation of the workflow, detailing each member assigned to each task, and the planned start and end dates for every phase. The chart will serve as a reference tool for effectively tracking and management of our project's progress throughout the semester.

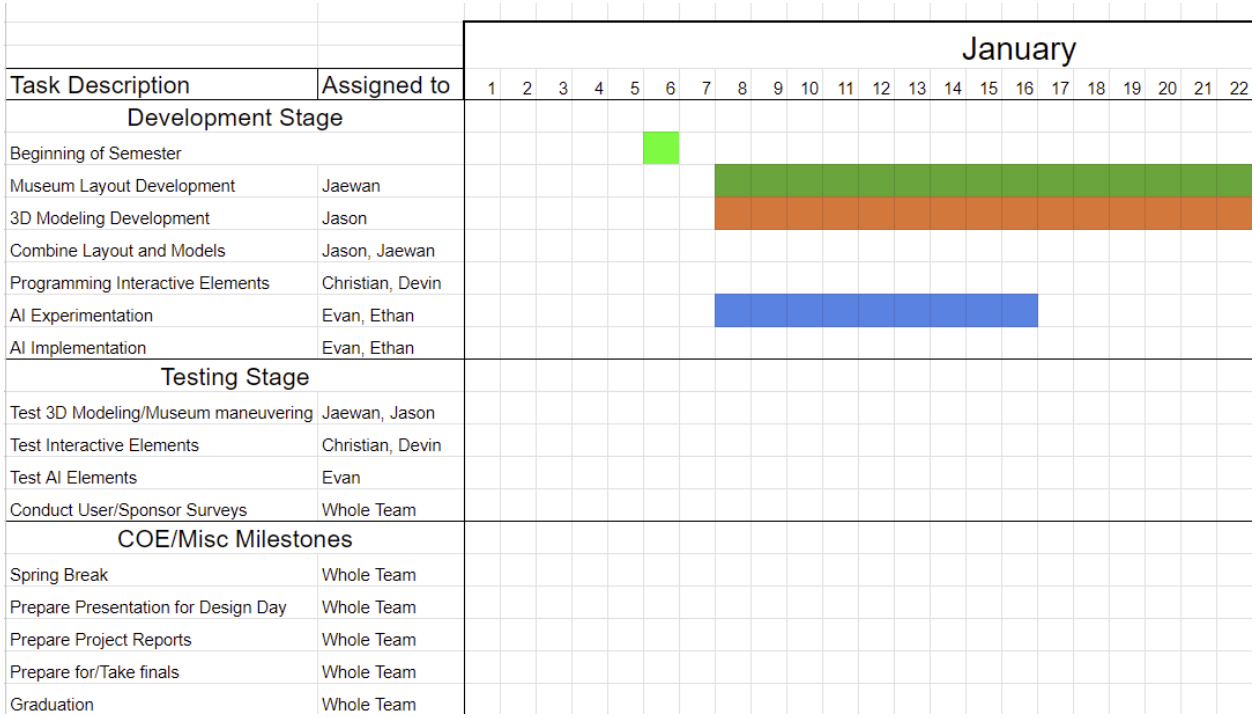
Gantt Chart

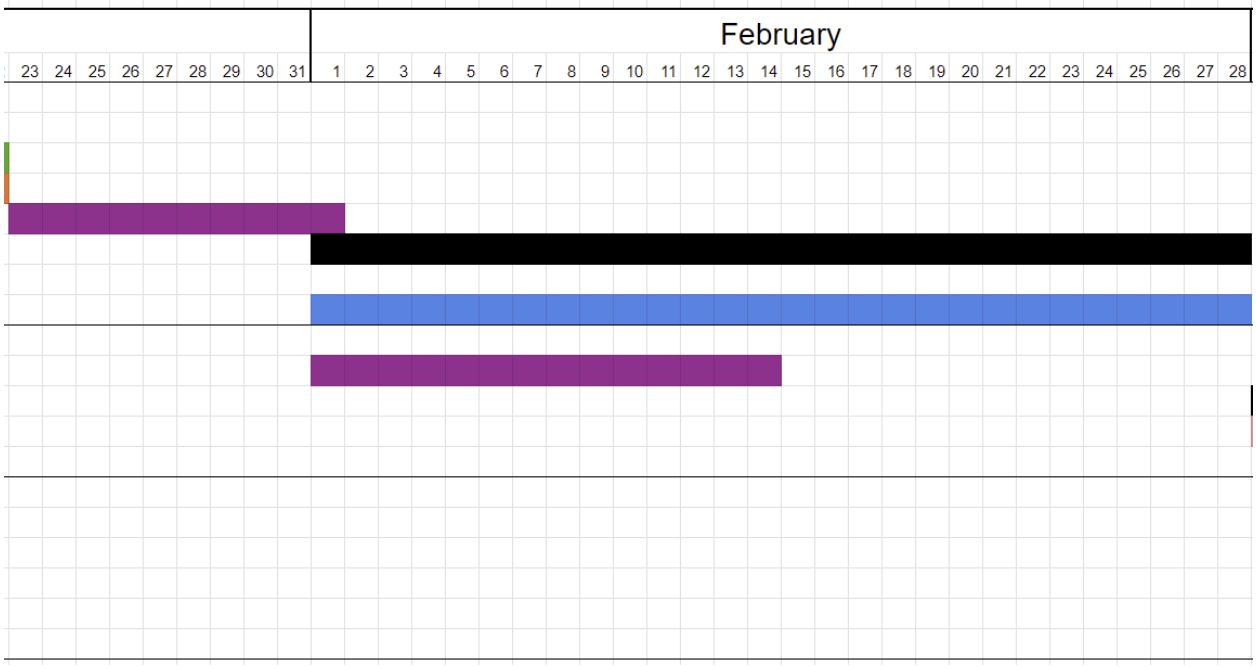
Color Key:

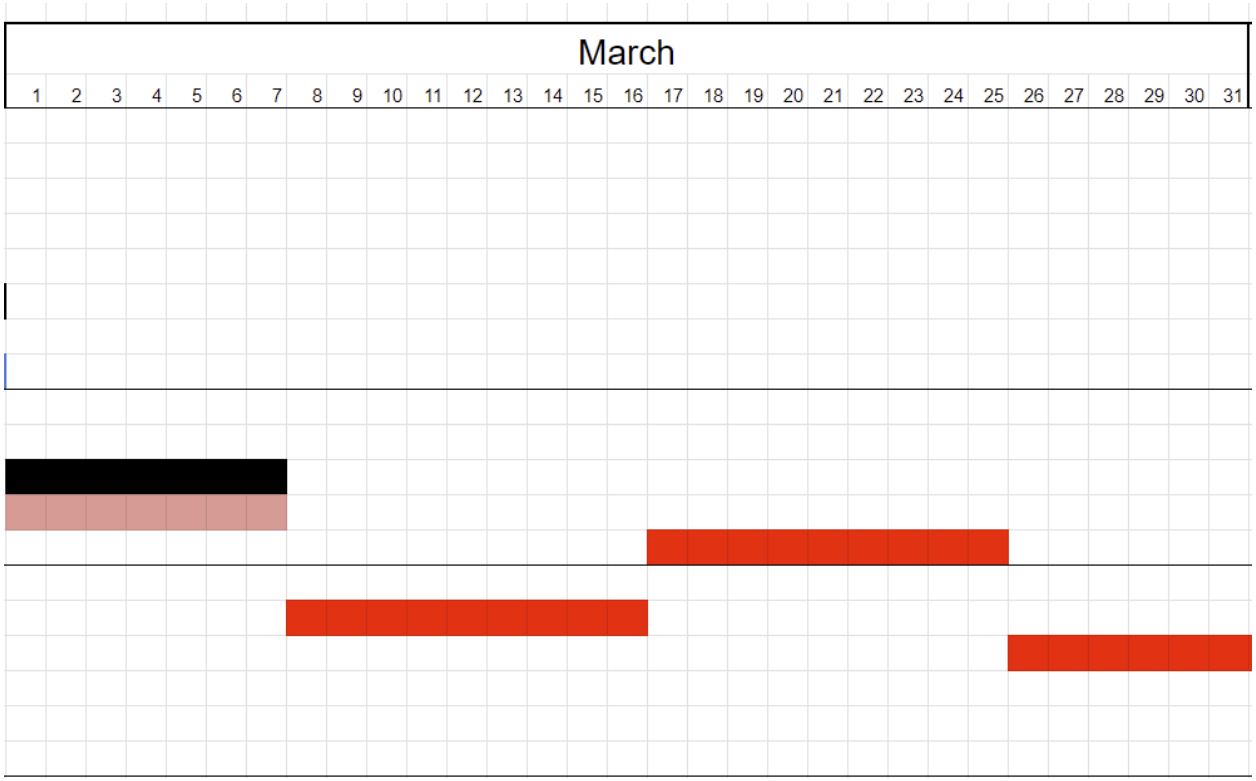
Start/End of semester	
Jaewan	
Jason	
Jason & Jaewan	
Christian & Devin	
Evan & Ethan	
Evan	
Whole Team	

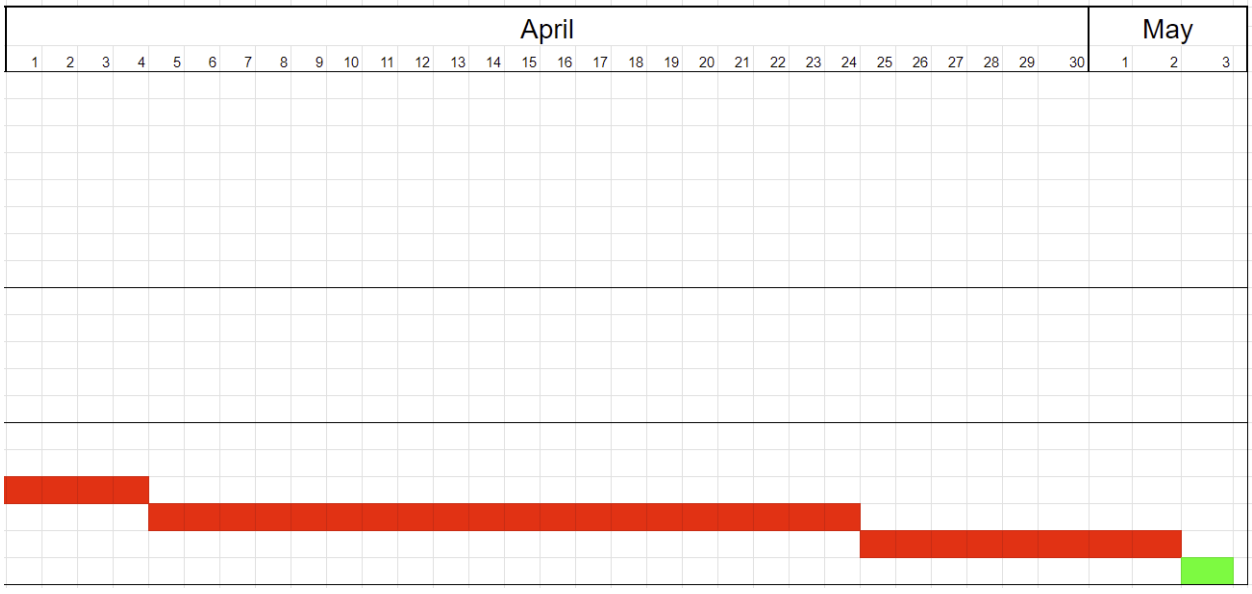
Note: Gantt Chart images in order from top to bottom

Task Description	Assigned to
Development Stage	
Beginning of Semester	
Museum Layout Development	Jaewan
3D Modeling Development	Jason
Combine Layout and Models	Jason, Jaewan
Programming Interactive Elements	Christian, Devin
AI Experimentation	Evan, Ethan
AI Implementation	Evan, Ethan
Testing Stage	
Test 3D Modeling/Museum maneuvering	Jaewan, Jason
Test Interactive Elements	Christian, Devin
Test AI Elements	Evan
Conduct User/Sponsor Surveys	Whole Team
COE/Misc Milestones	
Spring Break	Whole Team
Prepare Presentation for Design Day	Whole Team
Prepare Project Reports	Whole Team
Prepare for/Take finals	Whole Team
Graduation	Whole Team






March
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


April
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
May
1 2 3

The Gantt Chart above is split into three critical stages for our project: the **Development Stage,** the **Testing Stage**, and the **COE/Misc Milestones** (which includes finals, spring break, project reports, COE SD day, and graduation).

Development Stage:

Beginning of Semester Date: January 6

Museum Layout Modeling

Assigned to: Jaewan

Start Date: January 8

End Date: January 22

Description: Design the layout/model for the museum building itself

3D Modeling

Assigned to: Jason

Start Date: January 8

End Date: January 22

Description: Design the models for miscellaneous objects such as exhibit inclusions

Combine Layouts and Models

Assigned to: Jason & Jaewan

Start Date: January 23

End Date: February 1

Description: Combine the layout and the 3D models to create a completed baseline for the museum

Program Interactive Elements

Assigned to: Devin & Christian

Start Date: February 1

End Date: February 28

Description: Program the interactive elements that will be included in the exhibit

Note: This portion of development will likely take the longest and be the most difficult, and may begin earlier and end later than planned, since it might not even require a finished museum baseline to begin.

AI Experimentation

Assigned to: Evan & Ethan

Start Date: January 8

End Date: January 16

Description: Test the various AI tools to see if they can be used in the intended manner

AI Implementation

Assigned to: Evan & Ethan

Start Date: February 1

End Date: February 28

Description: Begin implementing the AI portions of exhibits into the museum

Note: This will be concurrent with programming the interactive elements, since the interactive elements and AI usage will be together. The dates are flexible like the Programming stage and Devin and Christian might provide assistance.

Testing Stage:

Test 3D Modeling/Museum Layout

Assigned to: Jaewan & Jason

Start Date: February 1

End Date: February 14

Description: Test run the museum's layout and models using the VR headset

Note: This portion of the testing stage can easily be done concurrently with the corresponding development stages, but time is given to it just in case

Test Interactive Elements

Assigned to: Christian & Devin

Start Date: March 1

End Date: March 7

Description: Test the interactive elements of the museum (go around interacting with the exhibits)

Note: This portion of the testing stage can also be done concurrently with the testing of the modeling and layout so dates are flexible

Test AI Elements

Assigned to: Evan

Start Date: March 1

End Date: March 7

Description: Test the elements of the museum that use AI

Note: This portion of the testing stage can also be done concurrently with the testing of the interactive elements, since the AI and interactivity go hand in hand

Conduct User/Sponsor Surveys

Assigned to: Whole Team

Start Date: March 17

End Date: March 25

Description: Present the finished and tested project to users/sponsors to ensure targets are met

COE/Misc Milestones:

Spring Break

Assigned to: Whole Team

Start Date: March 8

End Date: March 16

Description: Spring break. Some students will be traveling so time should be portioned with the expectation of no work being done.

Prepare Presentation for SD Day

Assigned to: Whole Team

Start Date: March 26

End Date: April 4

Description: Preparing presentation for senior design day. This stage will also include updating the museum based on user surveys.

Prepare Project Reports/Deliverables

Assigned to: Whole Team

Start Date: April 5

End Date: April 24

Description: Prepare project report/evidence book for end of semester

Prepare for/Take Finals

Assigned to: Whole Team

Start Date: April 25

End Date: May 2

Description: Prepare for and take final exams

End of Semester/Graduation: Date: May 3

Summary

Our Spring Project plan not only outlines the key milestones and tasks we need to complete for the AI VR COE museum project, but also who will carry out that task and when. With reverse planning in mind, our Gantt chart provides a detailed schedule for how we will proceed with creating and updating elements in our VR Museum. As shown in our Gannt chart, The VR development will be modularized into a development stage and a testing stage, where we plan on delegating tasks to members who specialize in specific tasks such as 3D Modeling Development and testing interactive elements. These deadlines not only remind us what to do, but they also keep us on task to make enough progress until we reach important milestones such as design day and finals.

Chapter Two: EEL 4914C/4915C

2.1 Spring Plan

Project Plan.

Build Plan.

Appendices

Appendix A: Code of Conduct

FAMU/FSU College of Engineering

Department of Mechanical Engineering

Code of Conduct

Team 314 VR AI Museum of the Famu-FSU COE

Names:

Christian Higgs
Devin Nobles
Ethan Myers
Evan Rundlett
Jaewan McPherson
Jason Muse

Date: 09/18/2024

Mission Statement

Team 314 is committed to ensuring a positive work environment that supports professionalism, integrity, respect, and trust. Every member of this team will contribute a full effort to the creation and maintenance of such an environment in order to bring out the best in all of us as well as this project. The purpose of the team is to cultivate a VR museum experience for people interested in AI and the hybrid of engineering and artistic concepts.

Roles

Each team member is delegated a specific role based on their experience and skill sets and is responsible for all here-within:

Team Leader – Jaewan

Manages the team as a whole; develops a plan and timeline for the project, delegates tasks among group member according to their skill sets; finalizes all documents and provides input on other positions where needed. The team leader is responsible for promoting synergy and increased teamwork. If a problem arises, the team leader will act in the best interest of the project.
He keeps the communication flowing, both between team members and Sponsor. The team leader takes the lead in organizing, planning, and setting up of meetings. In addition, he is responsible for keeping a record of all correspondence between the group and 'minutes' for the meetings. Finally he gives or facilitates presentations by individual team members and is responsible for overall project plans and progress.

Team members:

AI Implementation - Evan

Oversees the incorporation of Artificial Intelligence into the design of the museum. Responsible for making decisions on where AI should be used and how it will be used. Will use generative AI such as ChatGPT and image generating AI to assist in creative design in a majority of the exhibits of the museum. Will also have a responsibility to test the exhibits that use AI after it has been incorporated to ensure functionality.

Creative Director - Ethan

Takes charge of the creative direction and implementation of the project. Keeps line of communication with the lead ECE. He is responsible for knowing details of the creative designs used, and presenting the options for each aspect to the team for the decision process. Keeps all design documentation for record and is

responsible for ensuring designs are completed. Shall also analyze and implement technical solutions to achieve desired results.

Blender Expert - Jason
Responsible for the implementation of blender for 3-D models and animations for interactive objects and NPCs. Primarily focused on creating high quality models for the interactive objects, the non-player characters (NPCs), the environments, and any other 3D models required for the project. Also focused on creating smooth and immersive animations for appropriate models, ensuring compatibility with the game engine and a consistent high quality style. Works closely with the creative director and programmers to ensure an intertwined development style where all cores are closely working together, ensuring that 3D models and animations fit the museum in terms of performance and aesthetics.

Primary Software Engineer - Chris
Will oversee the software design of certain aspects of the museum using C# and Python. Some exhibits will include interactive elements which will need to be incorporated using C#. They will assist the Creative Director with coming up with the ideas for interactive designs and will implement them in the program. They will cooperate with the secondary software engineer to ensure that their program runs smoothly and does as it's supposed to.

Secondary Software Engineer - Devin
Will assist the Primary software engineer in the implementation of interactive elements using C# and Python. Will analyze the primary software engineer's code to ensure that it is accurate and will debug when necessary. They will also provide ideas to the primary software engineer in the event that they get stuck on a problem and they will bounce ideas off of eachother.

Unassigned Tasks -
In the event that there are some duties that are not directly stated under any of the assigned roles, then the group will discuss the assignment of these duties. This discussion will occur during a team meeting or, if someone is unable to attend, will be held in the group text. If possible, these duties will be split equally among the group so that no one is overwhelmed by their work. If one student is done with their specific task ahead of the others, then these unassigned tasks will be given to them so that they can continue to contribute.

All Team Members:

- Work on certain tasks of the project
- Buys into the project goals and success
- Delivers on commitments
- Adopt team spirit
- Listen and contribute constructively (feedback)
- Be effective in trying to get message across
- Be open minded to others ideas
- Respect others roles and ideas
- Be ambassador to the outside world in own tasks

Communication

The main form of communication will be over phone and text-messaging among the group, preferably phone as well as through regular meetings of the whole team. Email will be a secondary form of communication for issues not being time-sensitive. For the passing of information, i.e. files and presentations, email will be the main form of file transfer and proliferation.

Each group member must have a working email for the purposes of communication and file transference. Members must check their emails at least twice a day to check for important information and updates from the group. Although members will be initially informed via a phone call, meeting dates and pertinent information from the sponsor will additionally be sent over email so it is very important that each group member checks their email frequently.

Team meetings will be held at least once a week, with some weeks requiring two or three meetings. Every Wednesday the team will meet at 3:30 PM to discuss current assignments or work on the project. Mondays and Fridays will also be potential meetings days, depending on the amount of work and discussion needed in the week.

All Team meetings will be scheduled in a group text chat at least 12 hours ahead of the meeting time. The group texts will ensure that everyone understands the intention to meet and will deliberate on who will be able to attend and who will not. Meetings will be canceled if 4 out of 6 group members are unable to attend, and a future meeting will be scheduled as soon as possible

Any team member that cannot attend a meeting must give advance notice of at least 4 hours informing the group of his absence. Reason for absence will be appreciated but not required if personal. If a member misses 3 group meetings in a row and does not contribute on these assignments via google drive or some other cloud editing software and does not provide a reasonable excuse for his absence, then external support will be sought after. This external support will be sought from the sponsor and potentially the instructor, Dr. Chuy. In the worst case, the member might be dropped from the Senior Design class for refusing to participate in the group project.

Team Dynamics

The students will work as a team while allowing one another to feel free to make any suggestions or constructive criticisms without fear of being ridiculed and/or embarrassed. If any member on this team finds a task to be too difficult it is expected that the member should ask for help from the other teammates. If any member of the team feels they are not being respected or taken seriously, that member must bring it to the attention of the team in order for the issue to be resolved. We shall NOT let emotions dictate our actions. Everything done is for the benefit of the project and together everyone achieves more.

Ethics

Team members are required to be familiar with the NSPE Engineering Code of ethics as they are responsible for their obligations to the public, the client, the employer, and the profession. There will be stringent following of the NSPE Engineering Code of Ethics.

Dress Code

Team meetings will be held in casual attire. Sponsor meetings and group presentations will be business casual to formal as decided by the team per the event.

Weekly and biweekly Tasks

Team members will participate in all meetings with the sponsor, adviser and instructor. During said times ideas, project progress, budget, conflicts, timelines and due dates will be discussed. In addition, tasks will be delegated to team members during these meetings. Repeat absences will not be tolerated.

Decision Making

It is conducted by consensus and majority of the team members. Should ethical/moral reasons be cited for dissenting reason, then the ethics/morals shall be evaluated as a group and the majority will decide on the plan of action. Individuals with conflicts of interest should not participate in decision-making processes but do not need to announce said conflict. It is up to each individual to act ethically and for the interests of the group and the goals of the project. Achieving the goal of the project will be the top priority for each group member. Below are the steps to be followed for each decision-making process:

- Problem Definition – Define the problem and understand it. Discuss among the group.
- Tentative Solutions – Brainstorms possible solutions. Discuss among group most plausible.
- Data/History Gathering and Analyses – Gather necessary data required for implementing Tentative Solution. Re-evaluate Tentative Solution for plausibility and effectiveness.
- Design – Design the Tentative Solution product and construct it. Re-evaluate for plausibility and effectiveness.
- Test and Simulation/Observation – Test design for Tentative Solution and gather data. Re-evaluate for plausibility and effectiveness.
- Final Evaluation – Evaluate the testing phase and determine its level of success. Decide if design can be improved and if time/budget allows for it.

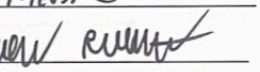
Conflict Resolution

In the event of discord amongst team members the following steps shall be respectfully employed:

- Communication of points of interest from both parties which may include demonstration of active listening by both parties through paraphrasing or other tools acknowledging clear understanding.
- Administration of a vote, if needed, favoring majority rule.
- Team Leader intervention.
- If a member does not provide a reasonable excuse after missing three meetings in a row or does not help on any assignments from home, then the instructor, Dr. Chuy, or sponsor, Dr. Bernadin, will be consulted.
- Instructor will facilitate the resolution of conflicts.

Statement of Understanding

By signing this document the members of Team 314 agree the all of the above and will abide by the code of conduct set forth by the group.

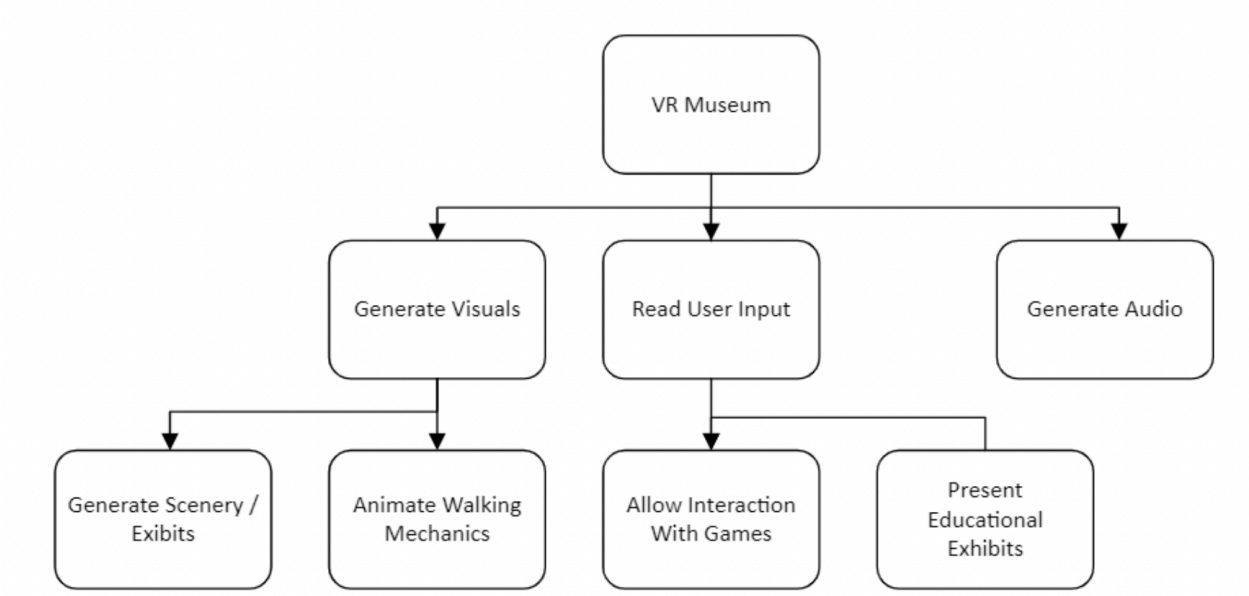
Name	Signature	Date
Jzewan McPherson		09/18/24
Evan Rundlett		9/18/24
Ethan Myers		09/18/24
JASON MUSE		9/18/24
Christian Higgs		9/18/24
Devin Nobles, Jr.	Devin Nobles	9/18/2024

Appendix B: Functional Decomposition

Introduction

This document outlines the functional decomposition of a VR Museum aimed at delivering an immersive and interactive experience for visitors. By utilizing tools like generative AI, spatial audio, and interactive games, the museum offers an engaging way for users to explore educational content. The function tree and table break down the major components and show how VR and AI elements collaborate to create a cohesive experience that meets user needs.

Function Tree



Cross Reference Table

Minor Functions	Major Functions				
		Generate Audio	Read User Input	Generate Visuals	Customer Needs
	Generative Scenery	-	-	x	1,2
	Animated walking mechanics	-	-	x	2
	Allow interaction with games	-	x	-	1,2,3
	Present educational exhibits	-	x	-	2,4

Modules input, output and description of the functional behavior

Level 1:

Module	VR Museum
Inputs	Blender, unity
Outputs	3-D VR environment
Functionality	Create a VR environment of an educational/artistic museum for users to explore

Level 2:

Module	Generate Visuals
Inputs	Generative AI, Unity, Blender
Outputs	Generative exhibits, animations, VR display
Functionality	Create immersion for users to feel more involved in the museum

Module	Read User Input
Inputs	Unity, C#, VR controller
Outputs	Playable games, educational exhibits
Functionality	Create exhibits that users can interact with through VR for a more entertaining experience

Module	Generate Audio
Inputs	Voice, Speech-to-text AI
Outputs	AI generated images, AI-generated voices/audio
Functionality	Incorporate generative AI so users can gain a better understanding of the use of AI in numerous functions

Level 3:

Module	Generative scenery/exhibits

Inputs	AI
Outputs	AI generated maze, AI generated images, AI generated audio
Functionality	Create exhibits that are unique for each individual to demonstrate AI-generative capabilities

Module	Walking animations
Inputs	Blender/3D modeling
Outputs	Animations and movement in Unity
Functionality	Develop a more immersive experience by providing movement mechanics

Module	Playable games
Inputs	C#, Python, Blender, Unity, VR controller
Outputs	First-person Pacman, Connect-4, etc.
Functionality	Provide users with a more interactive experience by having games in certain exhibits

Module	Educational exhibits
Inputs	Blender, Unity
Outputs	Artistic and historical displays
Functionality	Give users an educational experience within the museum

Summary

The VR Museum is divided into several key modules: generate visuals, read user input, and generate audio. Each module, developed using tools like Unity and Blender, plays a role in creating a rich and dynamic environment. By integrating these elements, the project creates a space where users can not only learn but also interact and enjoy the exhibits in a unique virtual setting. Some modules that are planned to be included are playable games such as an AI-generated maze, a connect-4 game where users can compete against an AI player, and multiple exhibits that utilize AI to cater the experience to each user. Numerous exhibits will include AI-generated art so that users can gain a better understanding of how AI can be incorporated into various types of projects in the future.

Appendix C: Target Catalog

See publication manual of the American Psychological Association page 62

Table 1

The Word Table and the Table Number are Normal Font and Flush Left. The Caption is Flush Left, Italicized, Uppercase and Lowercase

Level of heading	Format
1	**Centered, Boldface, Uppercase and Lowercase Heading**
2	**Flush Left, Boldface, Uppercase and Lowercase**
3	***Indented, boldface lowercase paragraph heading ending with a period***
4	***Indented, boldface, italicized, lowercase paragraph heading ending with a period.***
5	*Indented, italicized, lowercase paragraph heading ending with a period.*

References

There are no sources in the current document.