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Thesis

StAR

Department: Visual Communication Design
Degree: Master of Fine Arts in Visual Communication Design
College: College of Art and Design

Author: Qian Liao

VCDE-890 Thesis: Implementation Evaluation

Professor: Mike Strobert, Adam Smith

Date: December 19, 2023

RIT | College of Art and Design

Thesis Approval

StAR

Thesis Title

Qian Liao

Thesis Author

Submitted in partial fulfillment of the requirements for the degree of Master of Fine Arts

The School of Design | Visual Communication Design

Rochester Institute of Technology | Rochester, New York

Mike Strobert — Chief Thesis Advisor

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Adam Smith — Associate Thesis Advisor

Name — Title

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Abstract

This document demonstrates the design process of an Augmented-Reality visual interaction design for improving and enhancing the astronomical observing experience for amateurs. Astronomical observation can be fun and romantic when sharing the experience with friends, family, or someone special. Sharing those magnificent moments with friends and family when astronomical events happen could be joyful. However, there are some inevitable barriers. In order to have a successful meteor shower observation, observers must follow a series of strict and professional rules that make the experience usually unaffordable for amateurs. As a result, I proposed a new way for amateurs that combined user experience design and Augmented-Reality technology to reduce the difficulties of watching a meteor shower and enhanced the observing experience by using interactive design functions.

Keywords

AR, Star, Sky, Astronomical, UI/UX, Visual Design

Introduction

Astronomical observation can be fun and romantic when sharing the experience with friends, family, or someone special. Sharing those magnificent moments with friends and family when astronomical events happen could be joyful. However, there are some inevitable barriers.

Main Barriers and Problems

Light pollution: Light pollution from cities and urban areas can significantly reduce meteors' visibility. Glare from streetlights, buildings, and other artificial light sources can make it difficult to see faint meteors. To overcome this barrier, consider traveling to rural areas with low light and minimal pollution.

Weather conditions: Cloudy or overcast days can prevent you from seeing the meteor shower. Bad weather, such as rain, fog, or thick clouds, can prevent you from seeing any meteors. Checking the weather forecast in advance is essential to planning your meteor shower viewing.

Moonlight: The phase and brightness of the moon can also affect your ability to see meteors. A bright, full moon can wash out darker meteors, reducing the number of visible meteors. It is usually best to plan your meteor shower observations during the moonless or new moon phase of the darkest night sky.

Timing: Meteor showers occur at certain times of the year, and their peak activity may last only a few hours or a few days. It would be best to catch up on the shower's peak to see fewer meteors. Planning and knowing when and where to watch is crucial to observe a meteor shower successfully.

Light sources: Even if you find a dark place, be aware of your light sources, such as flashlights and smartphones. These can interfere with your night vision, making it harder to see meteors. Use red LED lights or cover flashlights with red cellophane to minimize the impact on night vision.

Location: The geographic location can also affect your ability to see certain meteor showers. Some meteor showers are better viewed from certain parts of the world. Research the best locations and directions for each meteor shower.

Not Shareable Experience

Besides those barriers, it could also be tricky for people from different places to see a meteor shower simultaneously, especially for people from different sides of the Earth. For example, it is only possible for people from China and the United States to watch the same meteor shower when both countries are geographically at night, and the required observing conditions are strict. For people from the East side of the United States, there is a 12-hour time difference between people in China during daylight saving time and a 13-hour time difference after the end of daylight saving time. This means the sunrise in China is usually sundown on the East side of the United States, and the sky from both countries is not dark enough to see the meteor shower. As a result, it isn't very easy for people from different sides of the world to share the same meteor shower observing experience.

Problem Statement

Astronomical observation quality will be affected by weather, location, and time. As a result, how might we bring the general amateurs an immersive and convenient astronomical observation experience?

Solution

The solution for simplifying the meteor shower observing experience is to design a virtual design system that cooperates with the Augmented-Reality technology. AR technology brought some of its advantages and specialties to my design solution that strengthened functionalities. Firstly, Augmented reality technology can superimpose digital information, images, or objects onto the real world to provide users with a rich interactive experience. This can make the task more engaging and entertaining. Secondly, AR can improve navigation and wayfinding by providing real-time information and directions within the user's field of view. This is especially useful for astronomical observers to locate the space in the sky the meteor will cross and help them find the best location to watch. Furthermore, for disabled observers, AR can improve accessibility by providing real-time information and guidance that enhances their ability to experience magnificent astronomical events.

User Scenario

Firstly, a user who is in the time or location that cannot watch the meteor, will put on the AR glasses, and receive a call from his or her friend who is ready to watch the meteor shower in the suitable time and location. The user's friend will request to synchronize and simulate his or her current environment and location where the meteor will occur. The user will confirm the request, and the AR glasses will synchronize and simulate the environment and location so that the user can see the same sky as his or her friend. Users can interact with their friends' holographic characters. Besides, users can choose and touch the meteor or any star or planet in the sky to zoom in and see it more clearly. In addition, users can interact with the 3D model of the astronomical object they choose to check its information, such as its introduction, structure, comparisons between other astronomical objects, and more.

Primary Functions

During the research process, I identified my primary target users, the meteor shower observing amateurs, who will take the observing experience as an interest. I utilized one quantitative research method to gather information from my target users. I arranged ten rounds of interviews with my target users and tried to understand their pain points, needs, and expectations for having a comfortable meteor shower. Based on their feedback, four primary functions are included in my design.

Environment Simulation (Page 8, Figure 10): Users can share their current night sky views with their friends by utilizing AR techniques to synchronize and simulate the environment.

Sky Explorations (Page 9, Figure 11): Users can find and observe an astronomical object or an astronomical event by interacting in the night sky environment simulation.

Immersive Interactions (Page 9, Figure 12): Users can interact with an astronomical object or an astronomical event in the environment simulation to view its information.

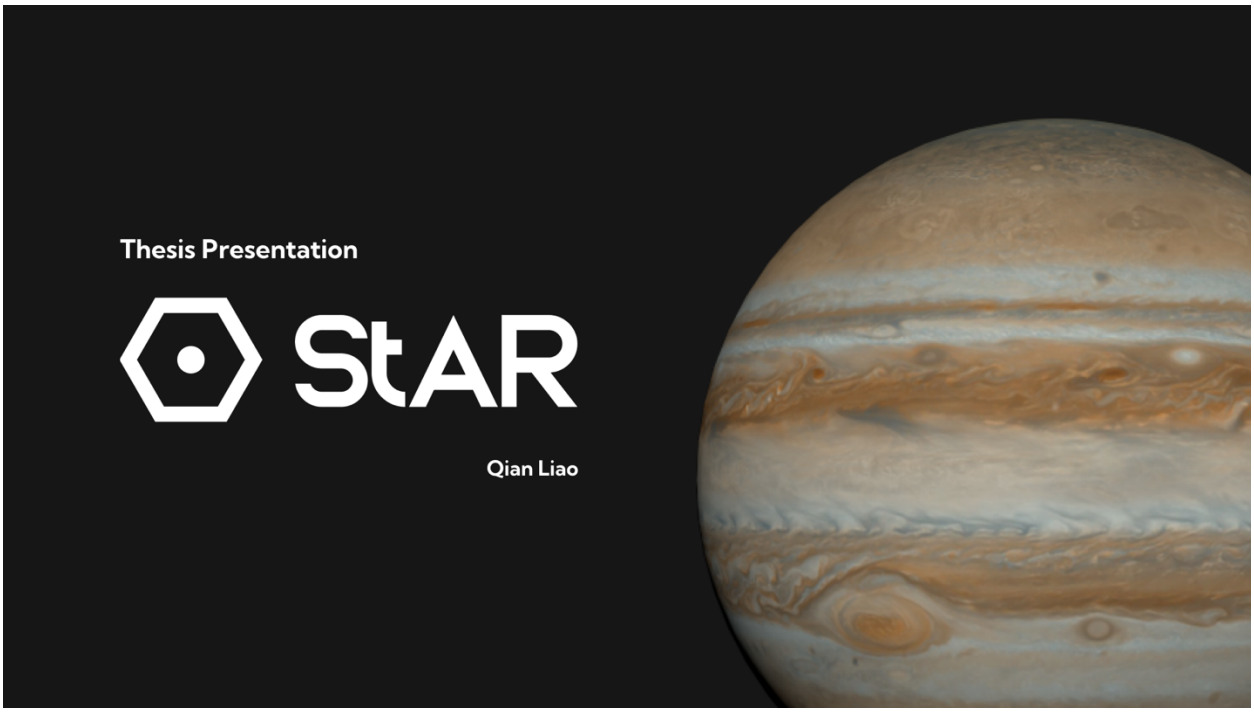
Interact for More (Page 10, Figure 13): There are more interaction options for users to learn about an astronomical object or an astronomical event.

I designed and created a video containing animations of each primary function to demonstrate their user experience processes. I presented this video to my target users for usability testing. My target users understood my design well and presented strong interest.

Conclusion

Based on the feedback from my usability testing with my target users, my proposed design solution and its functions offered them a new vision and method of seeing meteor showers. My solution gave my target users an immersive and convenient meteor-observing experience and made it sharable. One of my target users commented that my design would reduce the strict conditions usually required for a successful meteor shower observing experience and make it affordable for amateurs.
Augmented reality technology has unlimited potential. Applying AR technology to meteor observation makes it less professional but more normalized. My design will inspire more people to have an interest in astronomy. It will also speed up the research and development of the universe.

Appendix A: Thesis Defense Presentation



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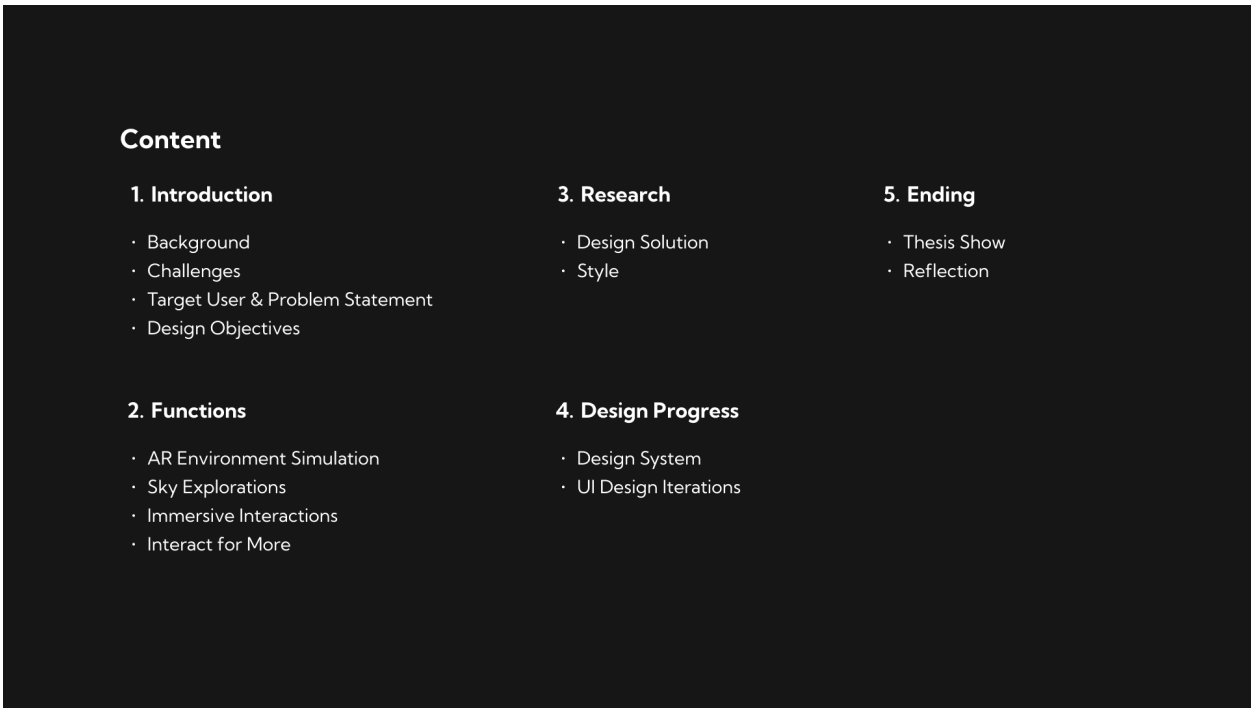

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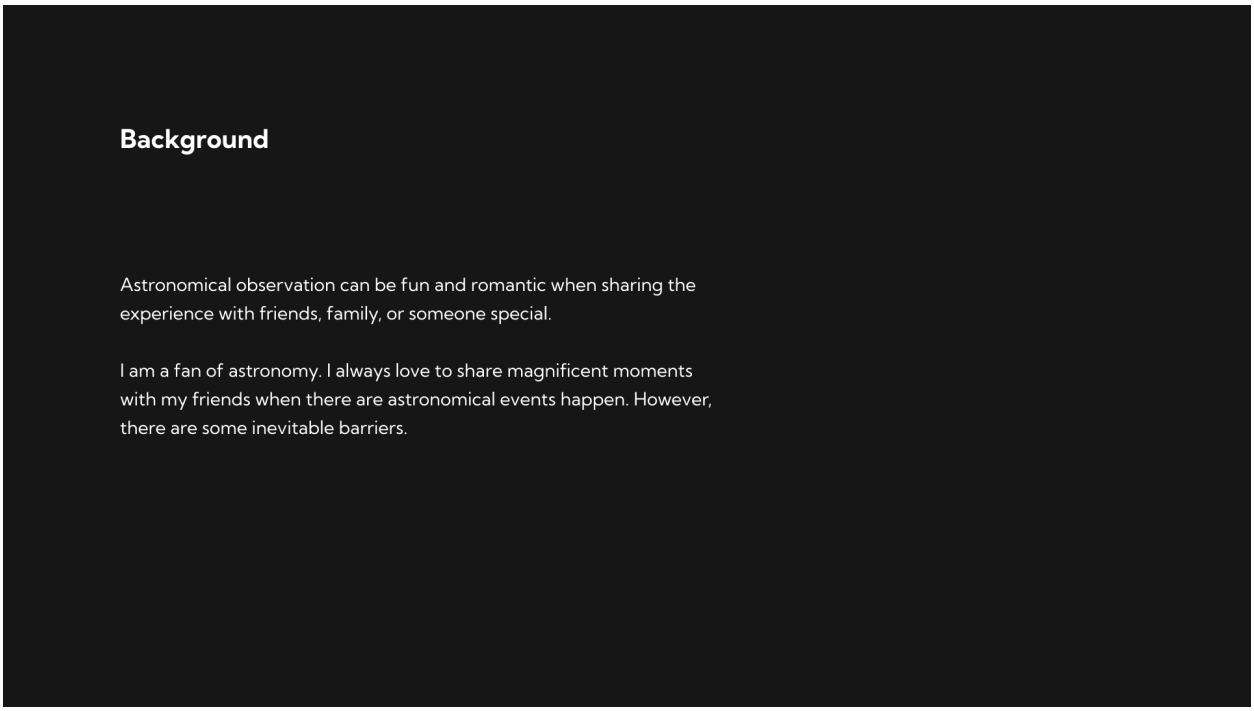

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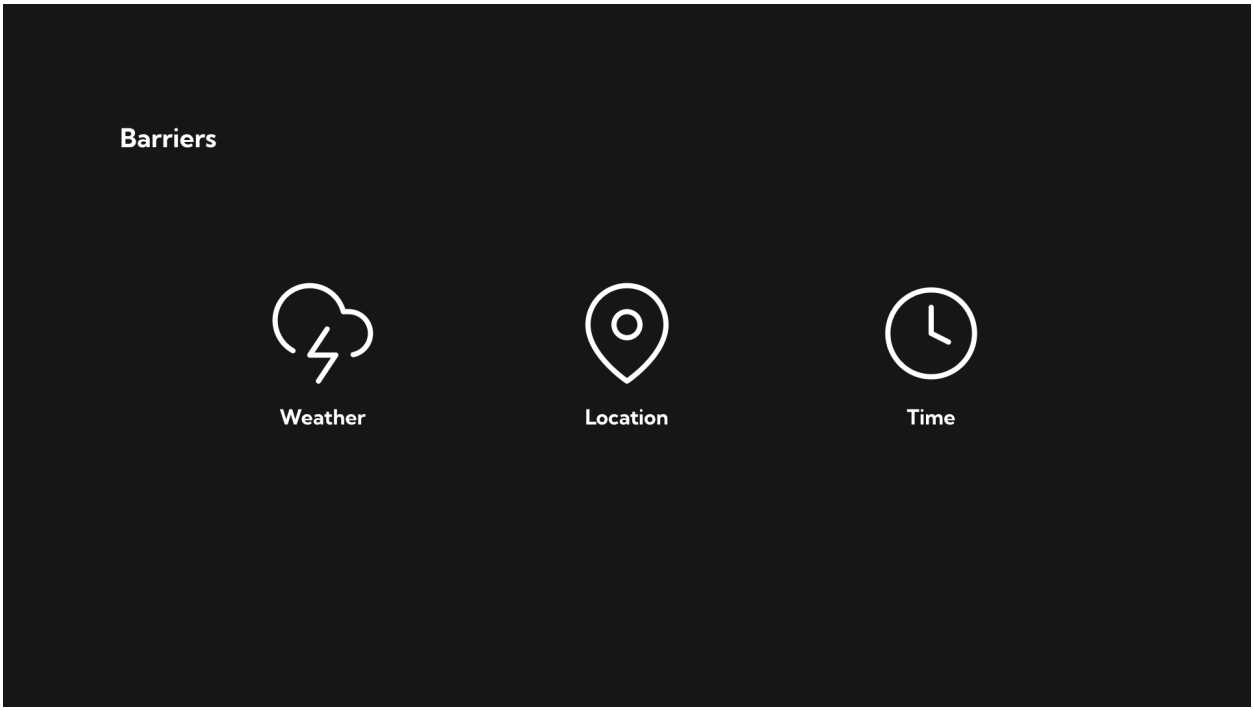

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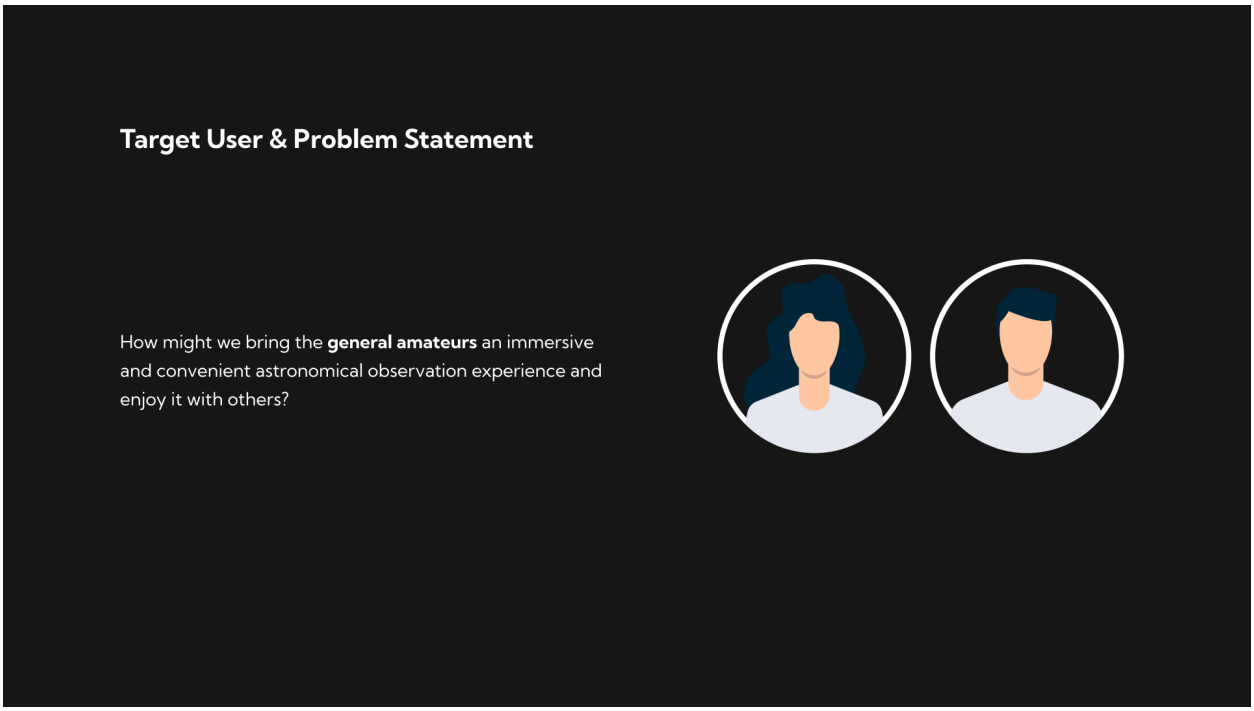

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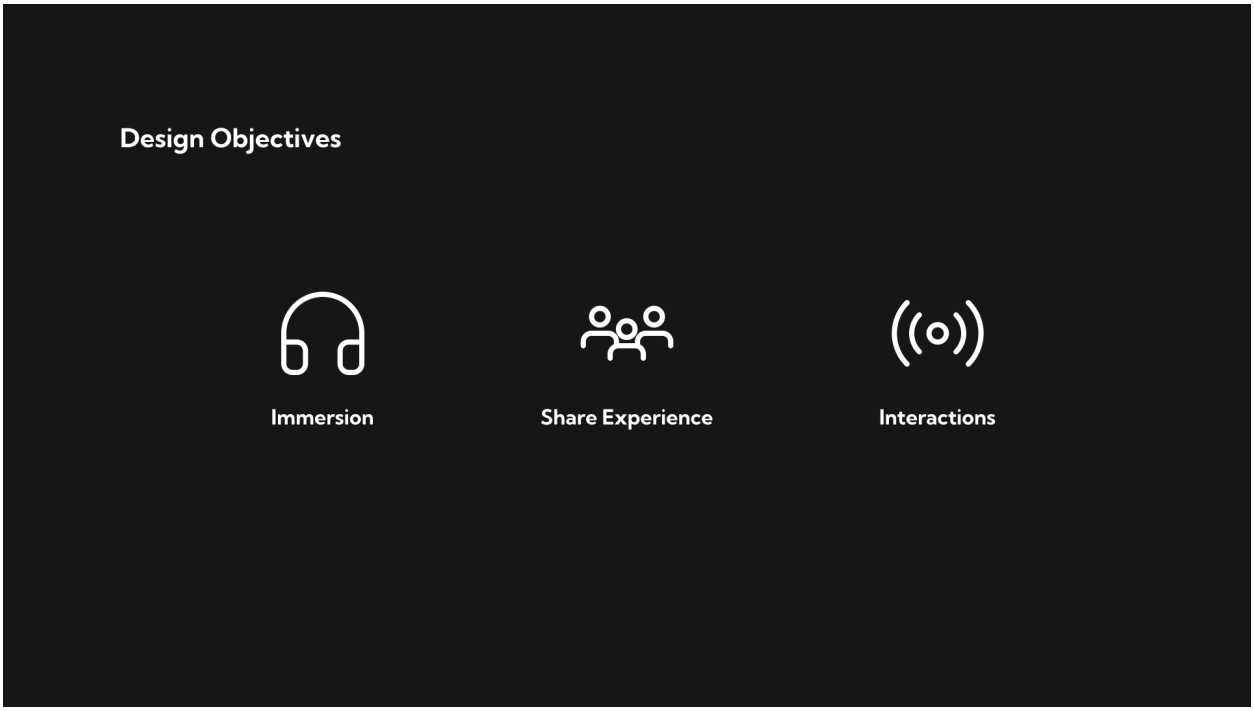

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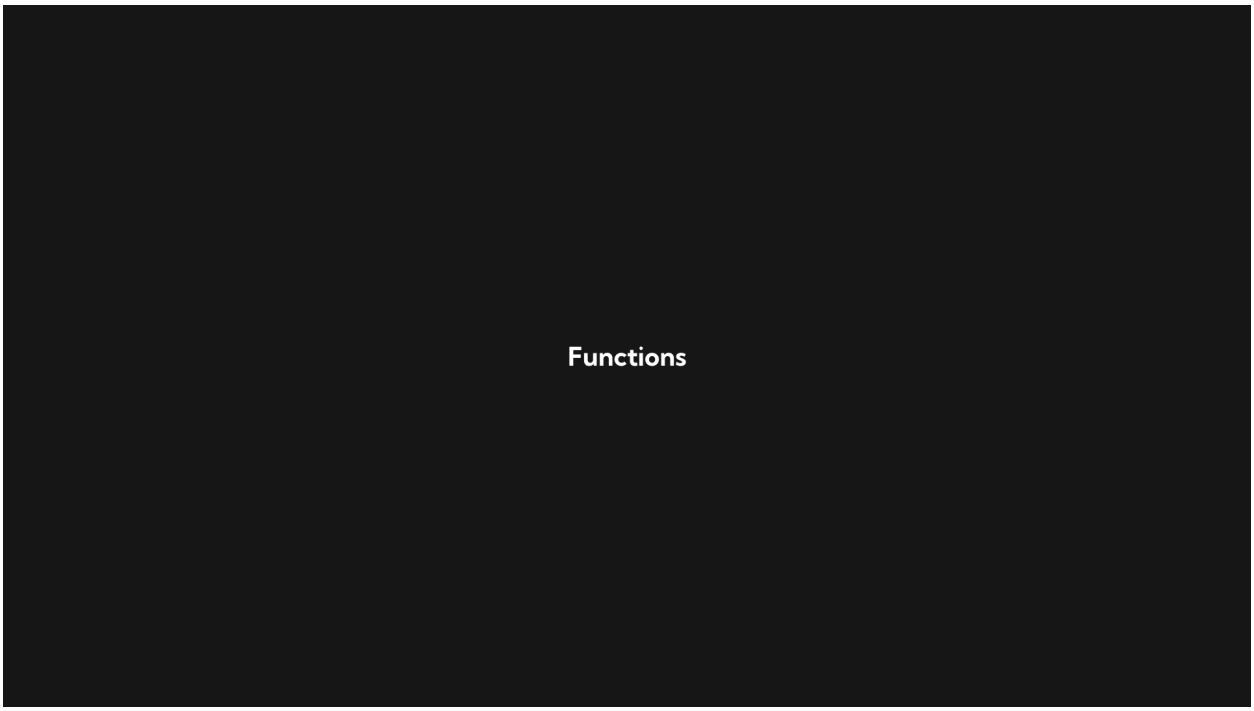

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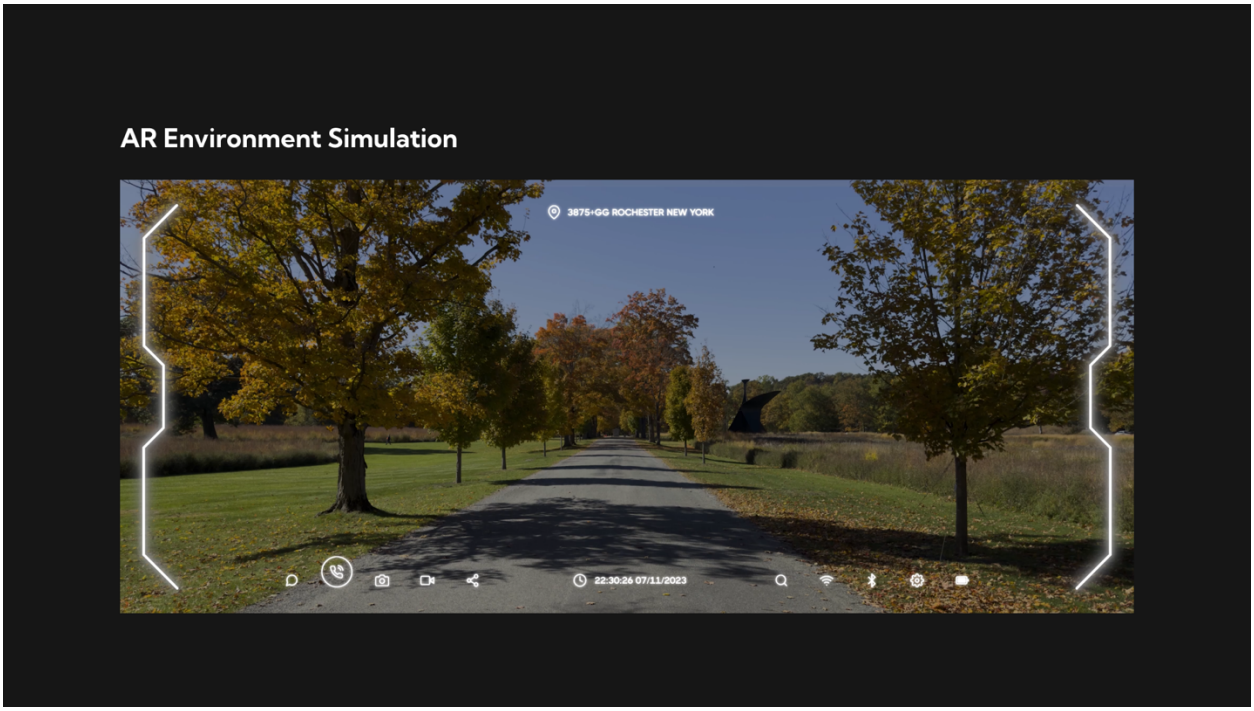

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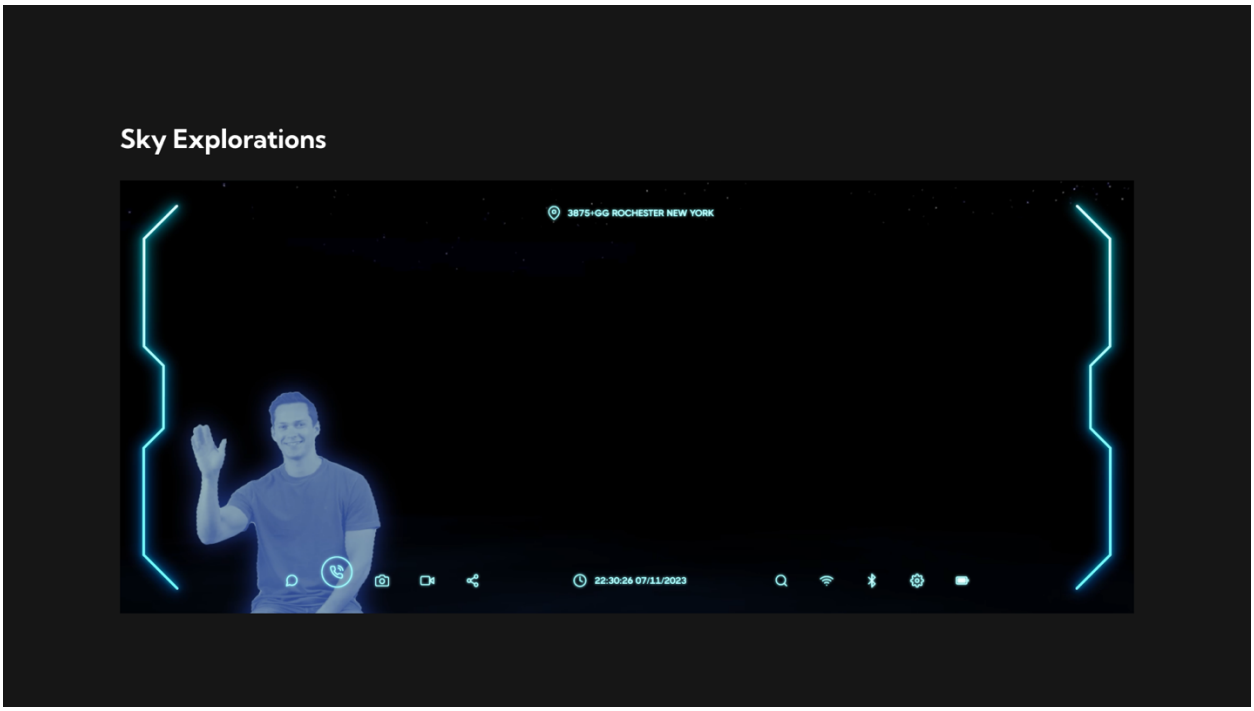

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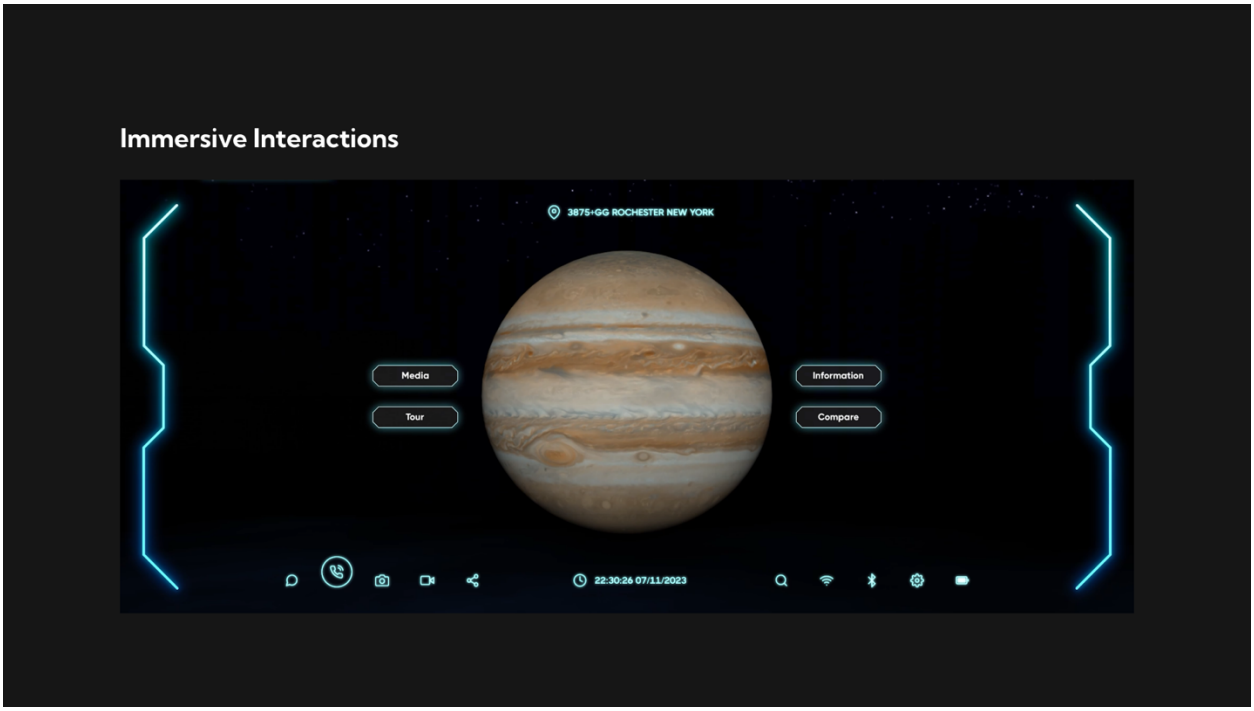

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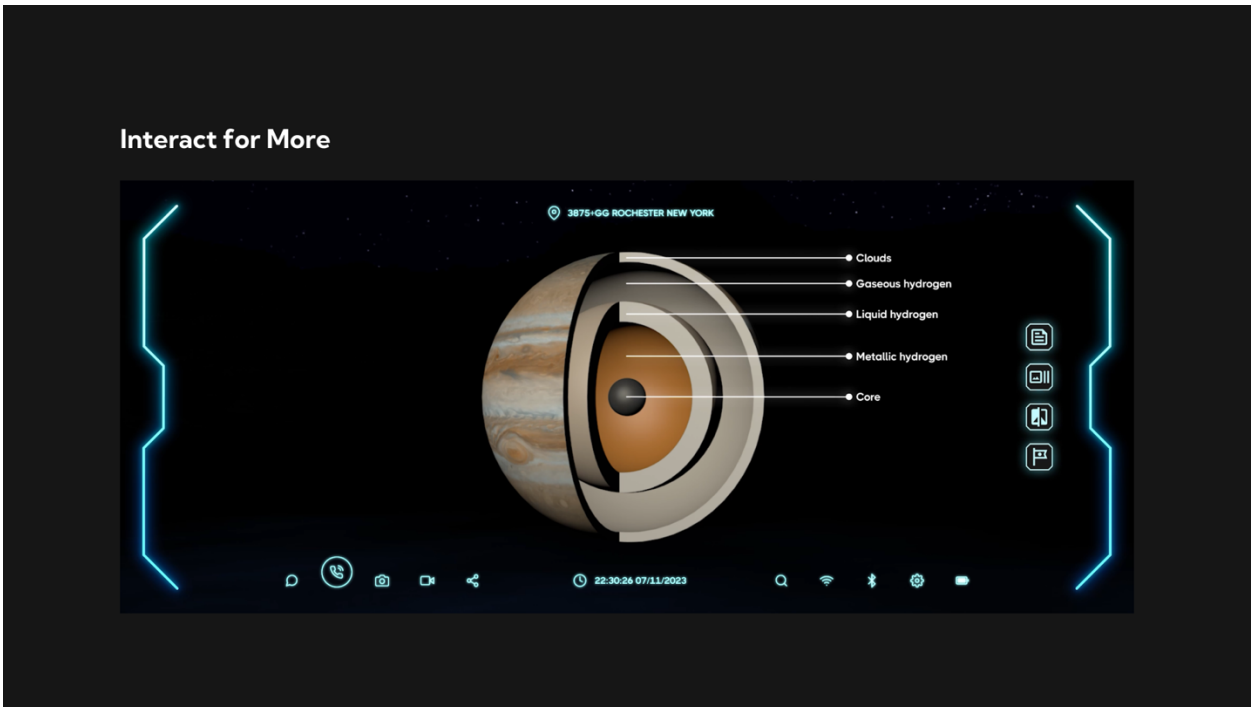

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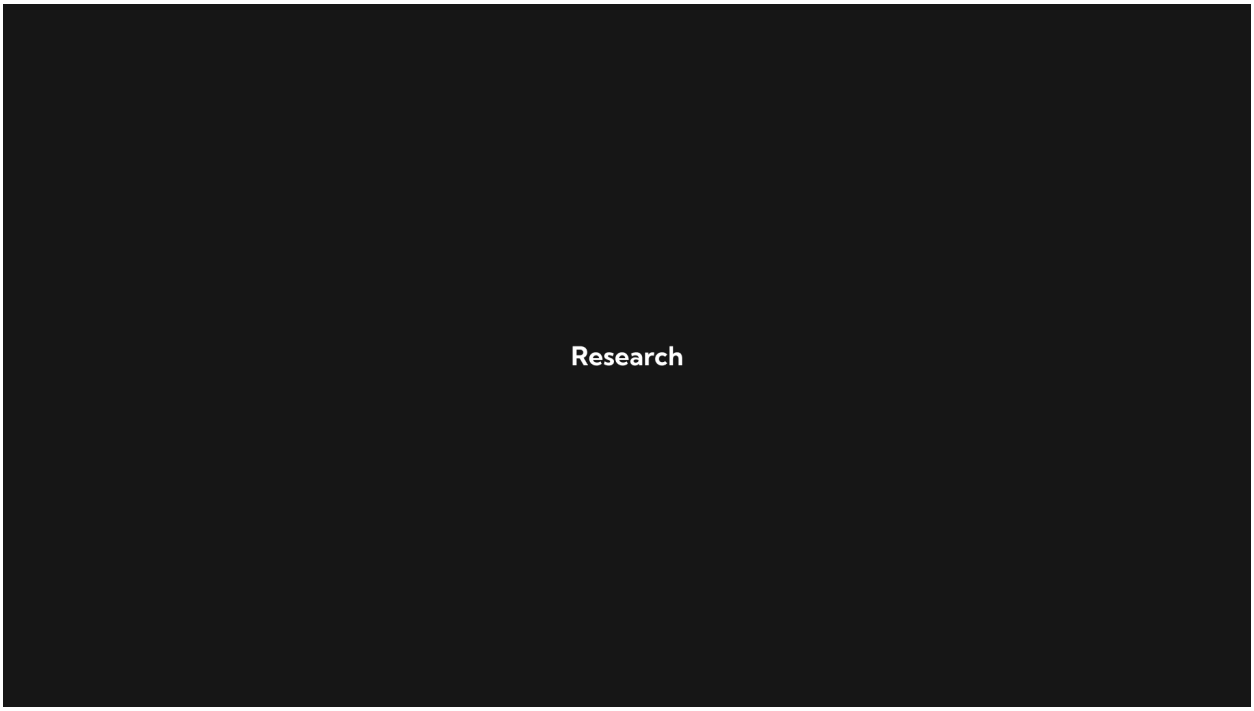

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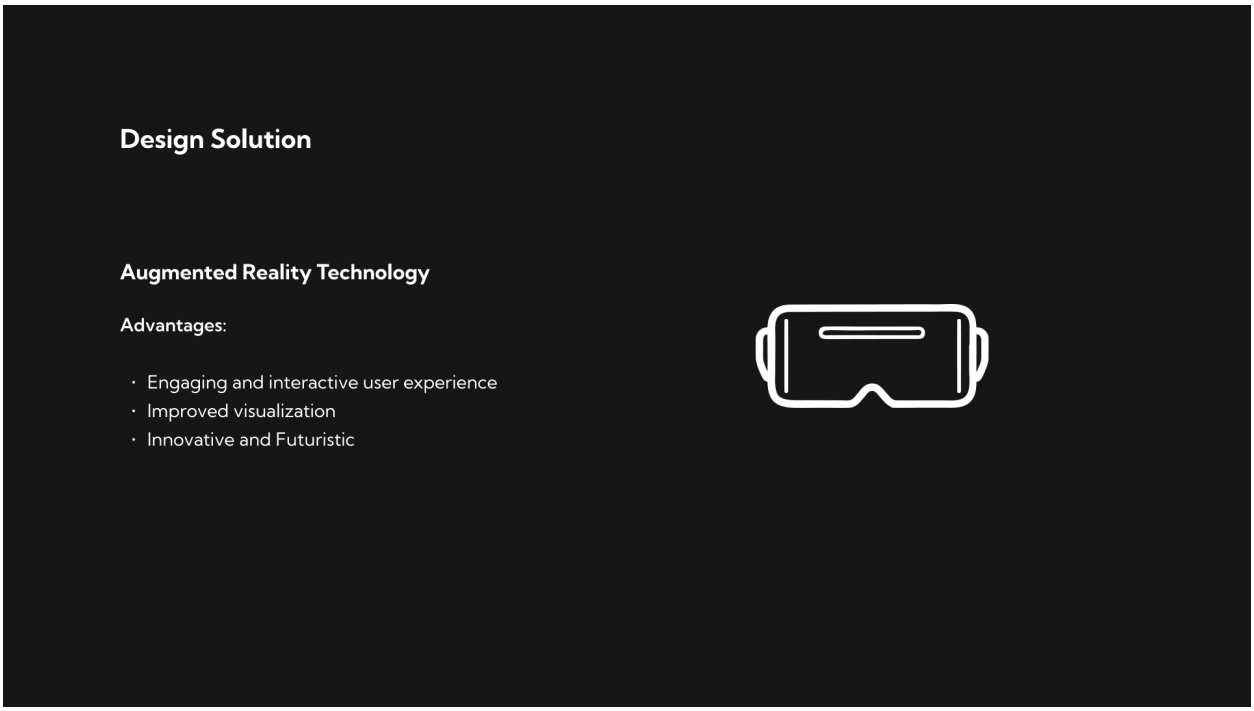

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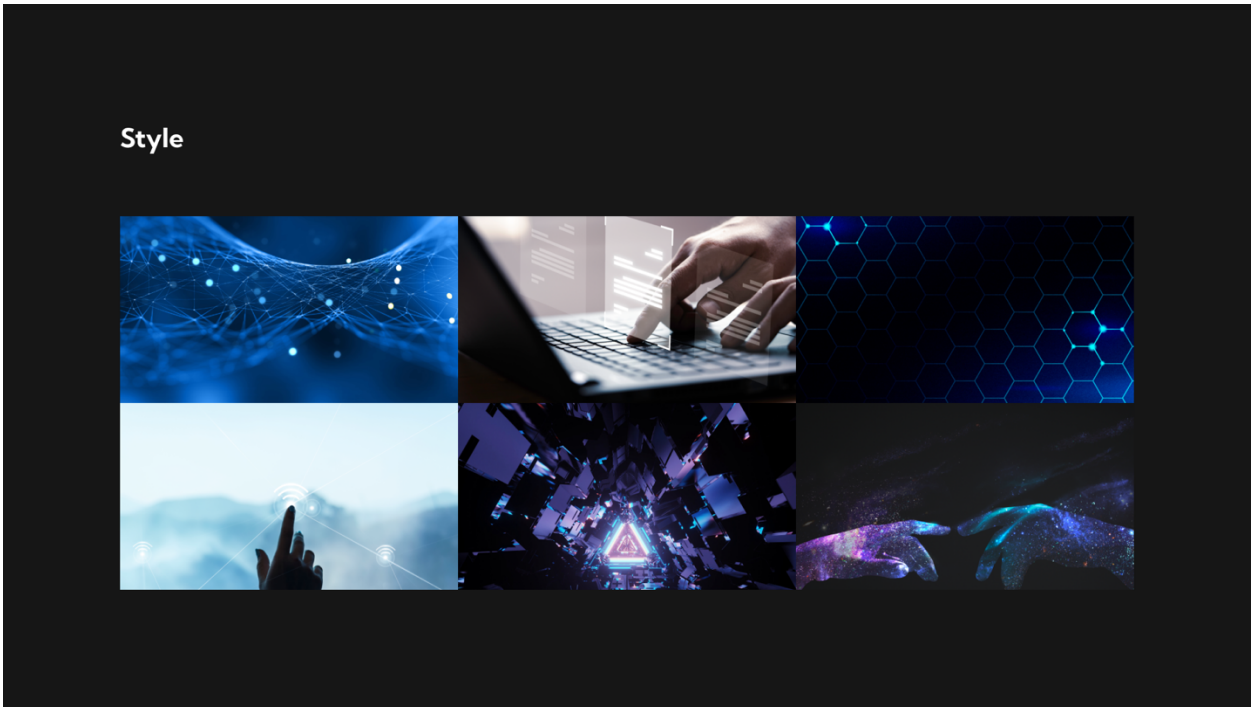

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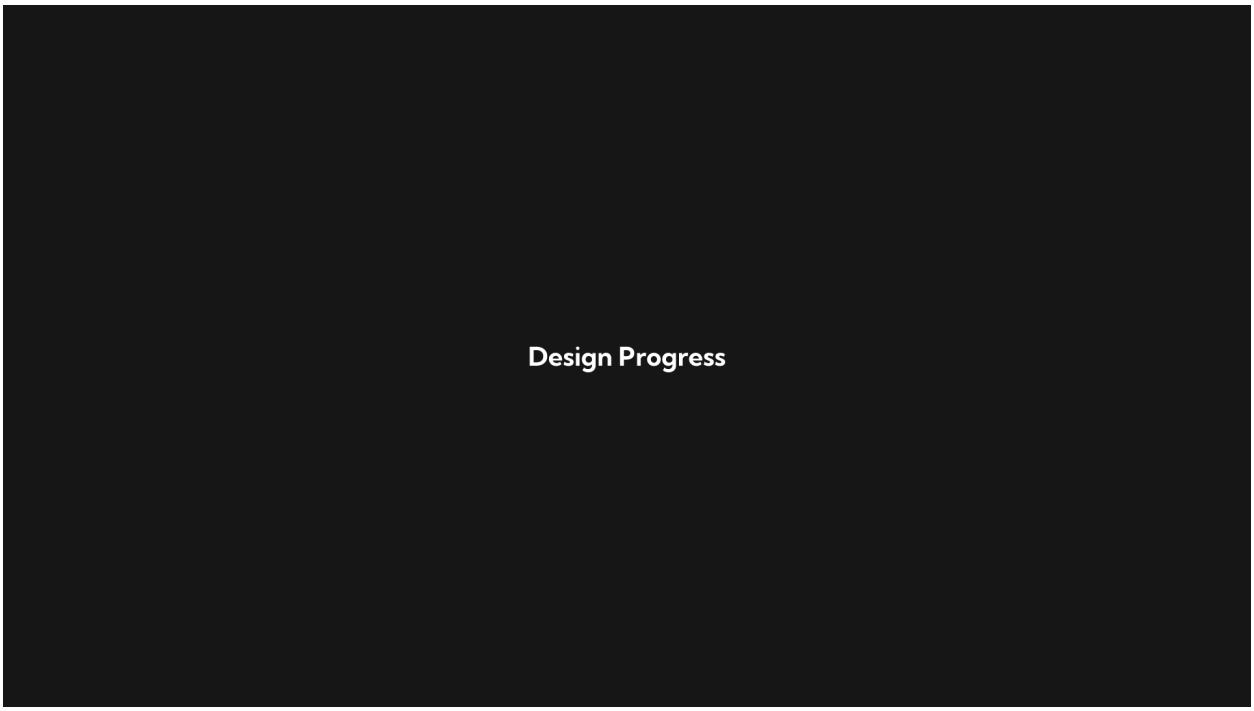

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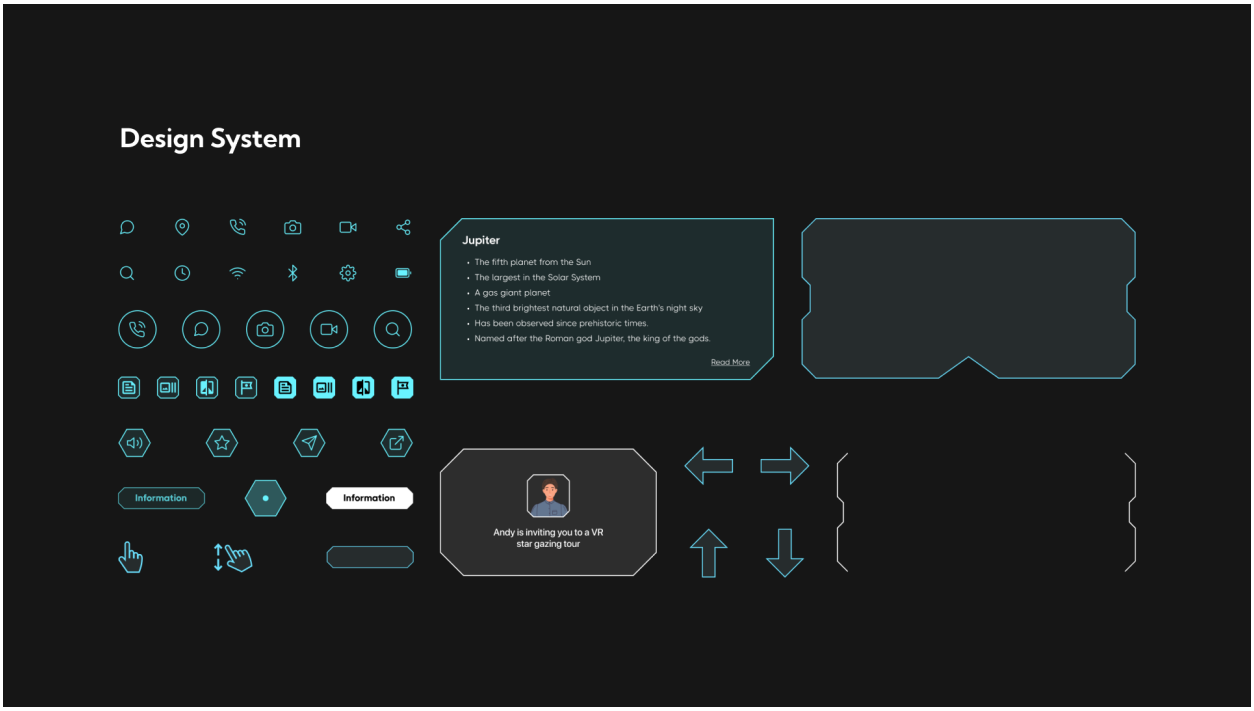

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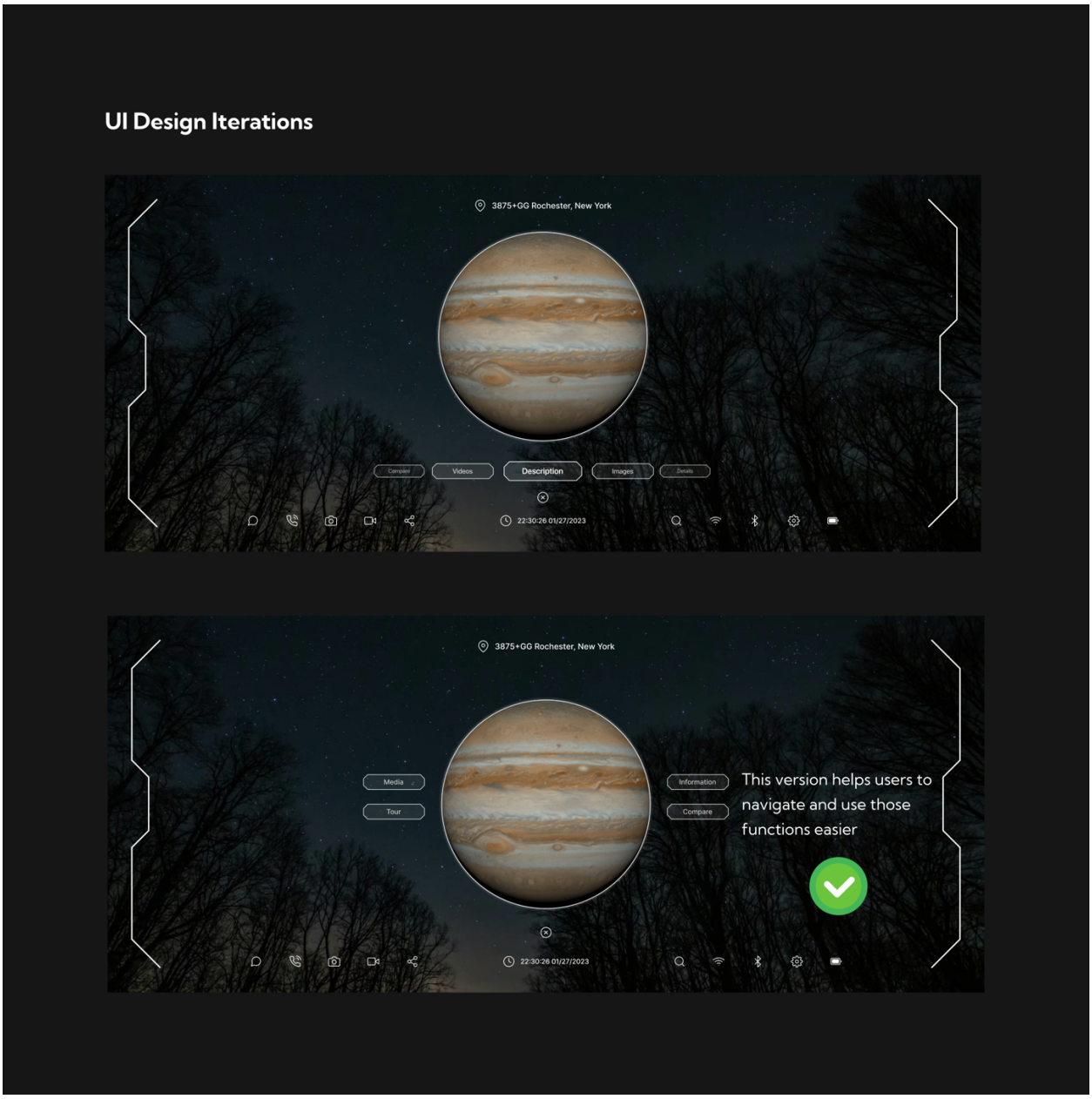

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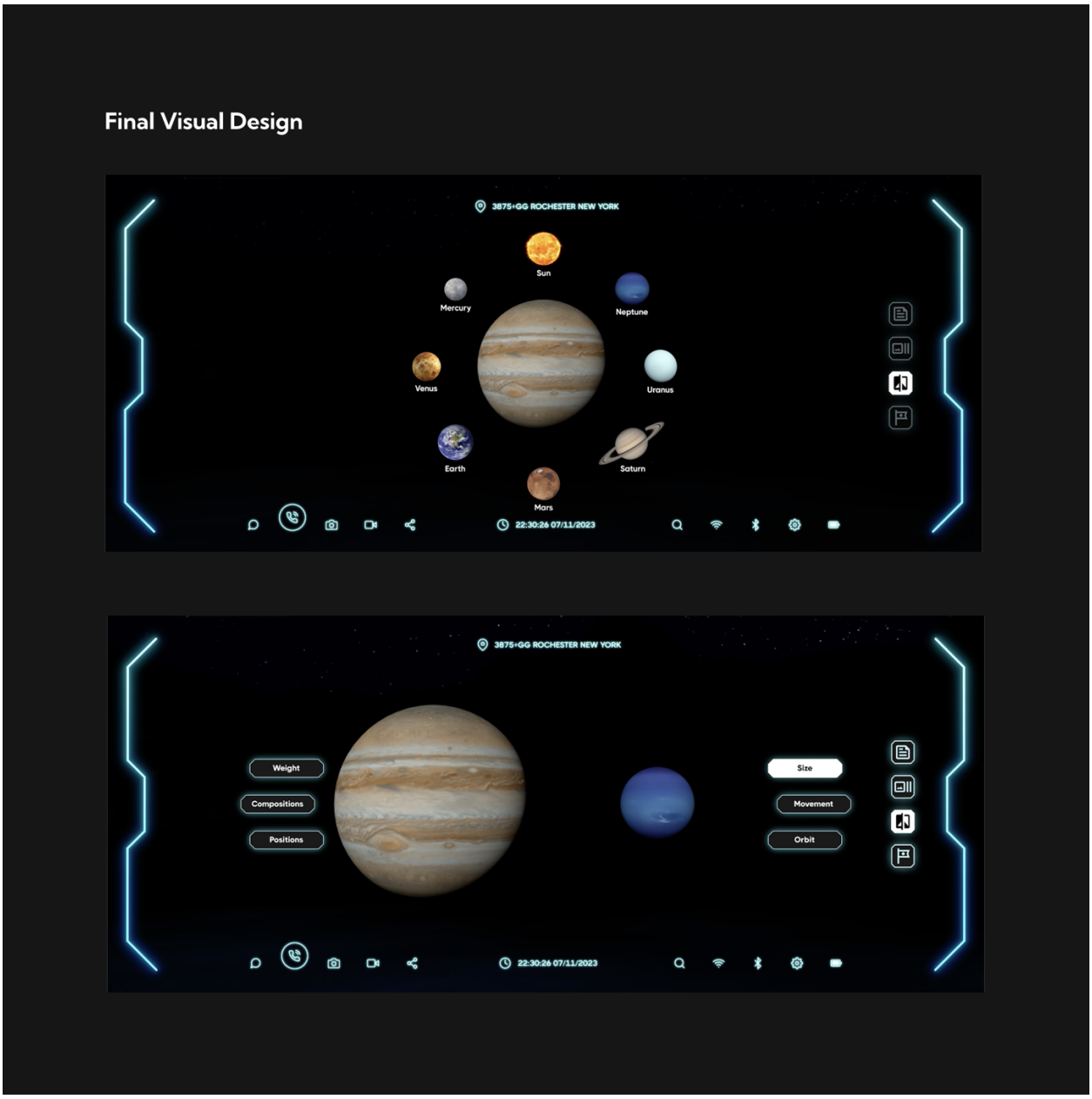

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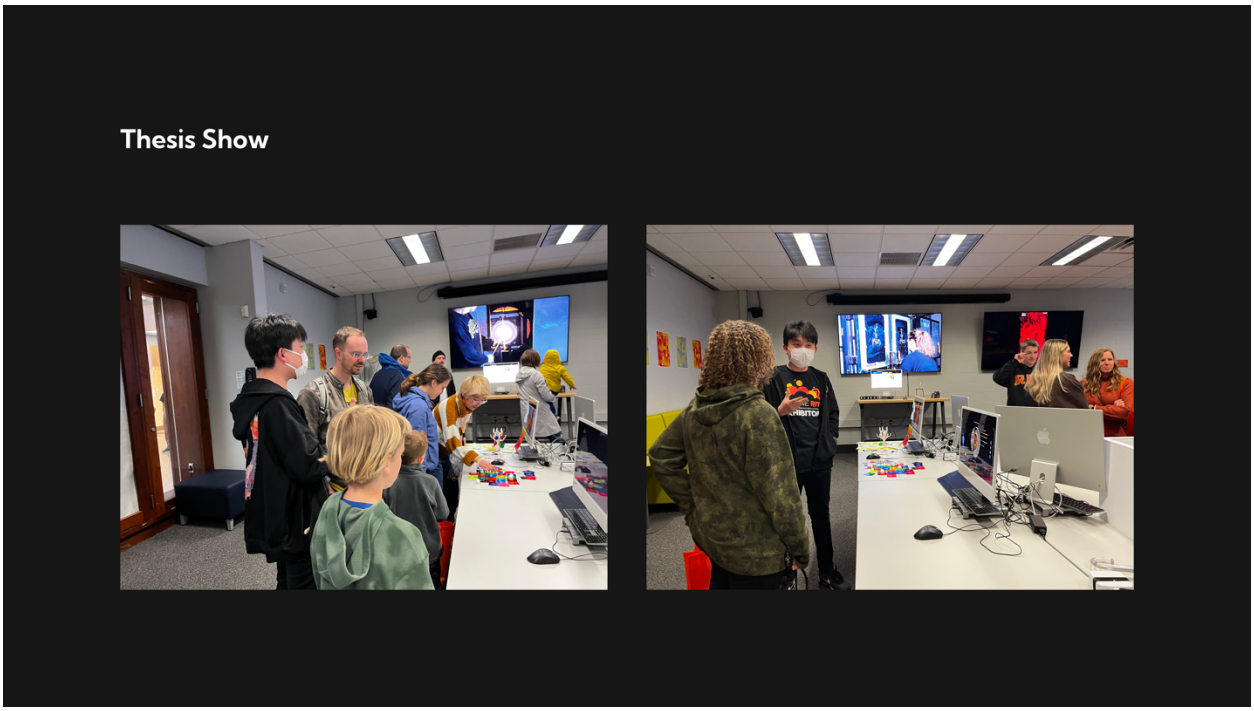

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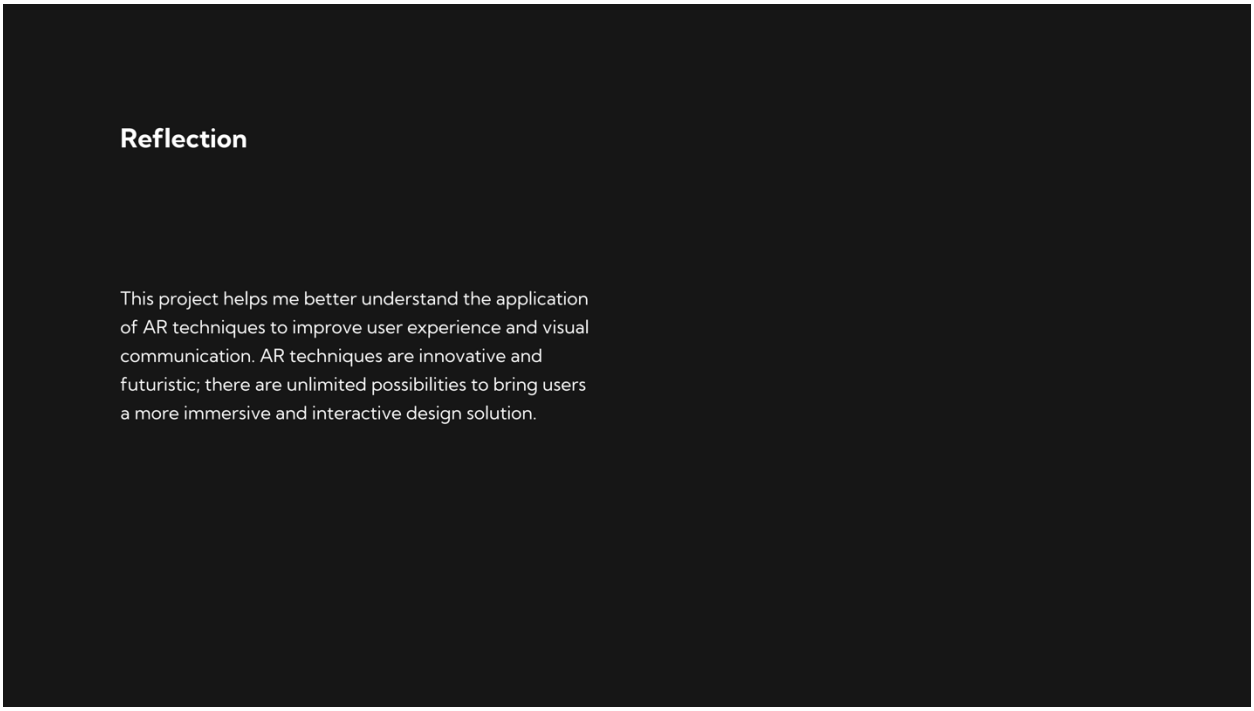

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Appendix B: Bibliography and References

Liao, Qian. Figure1_Cover. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Figure2_Content. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Figure3_Introduction. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

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Liao, Qian. Figure5_Background. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Figure6_Barriers. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Figure7_TargetUsersProblemStatememnts. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Figure8_DesignObjectives. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Figure9_Functions. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

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Liao, Qian. Figure24_ThesisShow. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Figure25_Reflection. 2023. https://drive.google.com/drive/folders/1H5shldUy0v7RYkscX4gR1SP-_5O53HJw?usp=drive_link.

Liao, Qian. Beginning AR Environment. 2023. https://drive.google.com/file/d/17yTWoKkYiUA57BilrrRmXcKaW8f4hNCk/view?usp=sharing-10s-11-11pro-new-iphone-12-12pro-12-mini-mock-up-screen-iphone-vector-illustration_20760774.htm#query=iphone%20mockup&position=6&from_view=search&track=sph.

Freepik. Avatar. 2023. ttps://www.freepik.com/free-vector/business-multinational-character-team-different-pose-diverse-office-worker-people-set-standing_18846541.htm#&position=27&from_view=undefinedisolated_4075544.htm#query=ipad%20mockup&position=3&from_view=search&track=sphk.

Qian. Liao. Jupiter Model. 2023. https://drive.google.com/file/d/1ZnA2Lc0cYA_5iDr9Q47UXtlQvlt8r_y0/view?usp=sharing.

Qian. Liao. Neptune Model. 2023. https://drive.google.com/file/d/1uBvnh9jyN5Bdg58WgN2MBBljROPZD-QK/view?usp=sharing

PNGWing. Mercury Image. 2023. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pngwing.com%2Fen%2Fsearch%3Fq%3Dinch%2BOf

%2BMercury&psig=AOvVaw3uZwRkiB8OCt8DxTAjPYl2&ust=1682346220649000&source=images&cd=vfe&ved=0CBMQjhxqFwoTCLCMtaeawP4CFQAAAAAdAAAAABADkup-isolated-white-backgroun

WIKIMEDIA Commons. Venus Image. 2023. https://commons.wikimedia.org/wiki/File:Venus_globe_-_transparent_background.pngckup-design_6895857.htm#page=9&position=13&from_view=undefined

Wikiquote. The Earth Image. 2023. https://en.m.wikiquote.org/wiki/File:Earth_Western_Hemisphere_transparent_background.pnge-mockup_3384952.htm#page=9&position=7&from_view=undefined

PIXELSQUID. Mars PNG. 2023. https://www.pixelsquid.com/png/mars-204613148324397647 6?image=G033498165.htm#page=8&position=11&from_view=undefined

Scope. Jupiter Surface Texture. 2023. https://www.solarsystemscope.com/textures/3s_PnwbQ/view?usp=share_link

WIKIMEDIA COMMONS. Saturn Image. 2023. https://commons.wikimedia.org/wiki/File:Saturnx.pnglcUcCepLYXTwsv3pfED/view?usp=share_link

WIKIMEDIA COMMONS. Uranus Image. 2023. https://commons.wikimedia.org/wiki/File:Uranus2-transparent.pngNXPmeSjOw46O/view?usp=share_link

Scope. Neptune Surface Texture. 2023. https://www.solarsystemscope.com/textures/3s_PnwbQ/view?usp=share_linkew?usp=share_linkHhjCobaeWI1NP1jh36xpPD/view?usp=share_link

Qian. Liao. System Component Designs. 2023. https://drive.google.com/file/d/1OUpCYvefKtRu-r_NMHEJci5xy3n_EBaf/view?usp=sharingNwx5Jm7eGjE/view?usp=share_link

Appendix C: Semplice Screenshot

StAR

Introduction

StAR is an AR astronomical observation tool that brings an immersive and interactive sharable star-gazing experience.

- **Designer:** Qian Liao
- **Major:** Visual Communication Design
- **School:** College of Art and Design
- **School:** Rochester Institute of Technology
- **Committee:** Mike Strobert, Adam Smith
- **Year:** Spring 2023

Background

Astronomical observation can be fun and romantic when sharing the experience with friends, family, or romantic special. Let's face it, however, astronomical observation can be unpredictable with the friends when there are astronomical events happen. However, there are some inevitable barriers.

Challenges

Astronomical observation can be affected by weather, location, and time. There are strict conditions needed to be fulfilled in order to have a successful observation with others.

Long Text Text

Problem Statement

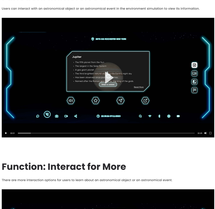
How might we bring people an immersive and convenient astronomical observation experience and enjoy it with others?

Design Objectives

Project StAR aims to offer an immersive, sharable, and interactive user experience of star-gazing.

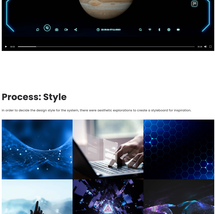
Function: Environment Simulation

Users can move their current night sky class with their hands by utilizing AR techniques to accommodate and simulate the environment.



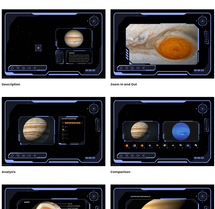
Function: Sky Explorations

Users can find and observe an astronomical object in an astronomical event by interacting in the night sky environment simulation.



Function: Immersive Interactions

Users can interact with an astronomical object or an astronomical event in the environment simulation to view its information.



Function: Interact for More

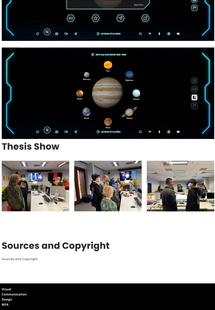
There are more interaction options for users to learn about an astronomical object or an astronomical event.

Process: Style

In order to decide the design style for the system, there were aesthetic explorations to create a styleboard for inspiration.

Process: Function Explorations

Brainstorming for functions that can present the strengths and advantages of AR techniques for enhancing astronomical observation.



Process: Design System

The design system helps maintain the unity of design elements.

Process: User Interface Explorations

The UI explorations helped provide sufficient design iterations to test and find the best design solution.

Version 1

In this version, users will slide the scrolling bar under the 3D model planet to select the functions to view different information.

Version 2

In this version, users will tap the functional buttons on the sides of the 3D model planet to view different information.

Version 3

In this version, users will see the windows of functions in the corners of the interface and drag one of the windows to the center of the interface to view information.

Version 4

In this version, users can slide to switch windows to view information.

Version 5

This version is similar to version 3 but with a simplified design of functional windows. Users can tap one window, and it will automatically come to the center of the interface.

Final UI Design

Thesis Show

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