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Space Journey: Encouraging astronomy education and space exploration through an interactive experiential design installation of an astronaut training program

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Encouraging astronomy education and space exploration through an interactive experiential design installation of an astronaut training program

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A Thesis submitted in partial fulfillment of the requirements for the Degree of Master of Fine Arts in Visual Communication Design

School of Design
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Encouraging astronomy education and space exploration through an interactive experiential design installation of an astronaut training program

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ABSTRACT

Space Journey is an interactive experiential design installation that explores the field of Astronomy and astronaut training programs, to encourage younger generations to follow scientific and astronomy education. This project has explored the boundaries of the interactive user experience — along with projection design — to learn, discover and experience. This has been done using a gesture-based interface to create an immersive experience.

Astronomy is a scientific field and has always had a significant impact on the world. It explores the wonders of the universe and its countless celestial objects through significant research. Astronomy has also been used to solve unknown questions about evolution and has propelled the development of technology that we know and use today. But while there have been astounding advances in technology, there remain several unanswered questions in the field of astronomy.

Before going into space, astronauts must endure many hours of training and preparation in which they learn about space, science and technology. Encouraging astronomy education in younger generations has the potential to improve the skills, motivation and knowledge to train like an astronaut. This could positively impact the world by inspiring new scientists and amateurs to keep exploring and researching the universe and, through them, science and technology could inevitably evolve.

This project presents different mind and body challenges that teach and entertain the users on how to train like an astronaut. By playing these challenges, the users gain different skills that are useful for astronauts in space. While playing, the users explore the wonders of the universe, learning not only about astronauts but space in general.

KEYWORDS

space exploration, astronauts, astronomy, technology, interaction, projection design, exhibition, user experience, experiential design, gesture-based interface, immersive experience, installation.

INTRODUCTION

Astronomical research and discoveries attract the human imagination by creating a connection between the origins of humans and the nature of the universe. Astronomy is the scientific field that explores the wonders of the universe and its countless celestial objects and has been used to solve questions related to evolution. It has also served as the catalyst for technological developments which is used today in everything from exploring space to everyday household appliances. But while there are a lot of advances in technology, there remain several unanswered questions in the field of astronomy.

Astronomy has always had a significant impact on the world and is a profitable way of learning the basic principles of scientific knowledge. Astronomical education has the potential to add significantly to science education and improve public science literacy. Research in the field has also revolutionized world thinking by continuously spreading updated facts about earth and its surroundings, while acting as a window into the unfathomable size and complexity of space.

Encouraging astronomy education in younger generations through an astronaut training program could positively impact the world by inspiring new scientists and amateurs to keep exploring and researching the universe. Through them, science and technology could inevitably evolve. This is important because astronomy contributes to the evolution of science and technology in a sense that it is always requiring new instruments and innovation to travel and research further in the universe. Inspiring younger generations to experience astronaut preparation and education will have an impact in the society in terms of technological evolution and knowledge of the universe.

To improve and encourage astronomy education, the goal of this thesis is to create an interactive, experiential design installation of an astronaut training program that uses a gesture-based interface, taking the user through an interactive journey into space. This creates user experience that provides them with fun challenges and a better understanding of astronaut preparation and the elements in space. In addition, the installation proposes the use of a gesture-based interface allowing the user to interact with the installation with his or her own hands.

Human interactivity has evolved through the years — specifically interactivity between humans and machines that have been developed through technological advances. Users, especially those in younger generations, have been raised in a world filled with digital devices that connect them with limitless knowledge, people and places without the need of moving from their location. There are new technologies every day and multiple ways to create interactions between users and devices. This thesis seeks to connect younger generations to the science behind astronomical education and astronaut training throughout the use of new technologies. Through this connection between the user and the universe, it would bring them more knowledge and enjoyment.

Gestures have been part of humans' nonverbal communication. Since the creation of "touch technology," the user has the capability of being closer to their actions by touching and making commands directly to their devices. But what if these commands came directly from their hands without the need for a device? Touchless gesture technology is relatively new. Some of these technologies include cameras or sensors that read users' movements, but have not seen successful widespread use.

The idea is to use a device or sensor which registers the dynamic hand motion to manage the projection on the installation, allowing the user to control it by using his or her natural language. This is much more intuitive and effortless when compared to touching a screen, mouse or remote control. Gestures can create a comfortable user experience that strives to understand the human language in a way that powers the next wave of electronic innovation.

REVIEW OF LITERATURE

The primary areas of research for this thesis were astronomy education, astronaut education, user experience, interactivity and experiential design.

Exploring research about astronomy helped broaden the horizons of the knowledge of astronomy and astronaut education and helped find a solution for encouraging astronomy education in younger generations.

In addition, it was important to navigate between the research that has been made on user experience and interactive and experiential design, to find a solution that adds to the field of design and also solved the problem efficiently.

Importance of Astronomy and Astronauts Education

“White Paper: The next 20 Years - A Vision for Planetariums in the 21st Century”
Staffan Klashed
Planetarium Design & Planetarium Software. August 11, 2015
http://sciss.se/news/id/34

This paper demonstrates the importance of the planetariums for astronomy education and entertaining and suggests that the planetariums change the perception of the public making them as a primary place to follow events in astronomy and space exploration. It also demonstrates through the paper the great interest in the audience towards planetariums and that it is necessary to maintain new technologies to properly educate and entertain, this is very relevant to this project because it could help find a solution to the problem presented in order to increase the interest in astronomy.

“The Role of Planetariums in Astronomy Education”
James G. Manning
Astronomy Education: Current Developments, Future Coordination Astronomical Society of the Pacific Conference Series. June 1994
http://articles.adsabs.harvard.edu//full/1996ASPC...89...80M/0000081.000.html

This journal describes the planetariums as environments that encompass the audience, and its role in the astronomy education in relation with the audience, expressing that it brings the planetariums and the public together into the experience in a way that classroom, book, television or computers screens cannot. That it combines and effectively use audiovisual technology to help create better experiences.

“Astronomy in Everyday Life”
Marissa Rosenberg, Pedro Russo, Georgia Bladon, Lars Lindberg Christensen
International Astronomical Union
http://www.iau.org/public/themes/astronomy_in_everyday_life/

This article the authors outline the reasons why astronomy is an important part of society, focusing mainly on the technology and the technology transfer. They describe the relation of astronomy with industries, energy, medicine and everyday life, showing the impact that astronomy has in the world, and its benefits through the investment are science and astronomy education.

“The Importance of Astronomy in Modern Education”
Evry L. Schatzman
August 1972
http://onlinelibrary.wiley.com/doi/10.1111/j.1749-6632.1972.tb12708.x/abstract

A Journal that expresses the importance of the scientific education emphasizing in astronomy and demonstrating why this scientific field. Also explains through part of history the influence of science in the major events on the past and the civilization.

“The Role of Astronomy in Education”
Astronomy and Astrophysics in the New Millennium. 2001
https://www.nap.edu/read/9839/chapter/7

In this book, the authors describe the role of the science education and astronomy and encourage the understanding in this matter, in order to creates success in educational projects in astronomy. Also it explains about how the astronomical community augments significantly to the continuing

effort to strengthen science education and adds that the interdisciplinary nature of astronomy and its natural links with technology and instrumentation position the field to contribute significantly to building a strong technical work force for the 21st century.

Gesture-Based Interface and Interactivity with Users

“The gesture interface: A compelling competitive advantage In the technology race”
Brian Dipert, Yair Siegel, Simon Morris, Liat Rostock, Gershom Kutliroff
EE Times. April 2013
http://www.eetimes.com/document.asp?doc_id=1280756

This online article declares the advantage of the gesture base interface and how it can be used for different purposes, it also states the different kinds of gestures recognition systems and its potential use in different fields, showing their advantages to technology, and its versatility to use in many situations as a natural type of communication.

“Gesture-Based Interfaces: Practical Applications of Gestures in Real World Mobile Settings”
Julie Rico, Andrew Crossan, and Stephen Brewster
Human-Computer Interaction Series. 2011

This chapter describes the aspects of gestures design for mobile gesture and body-based interaction, including the different methods that can be uses in different situations. It narrates a little bit of history of the gesture interface and its implications related with social acceptability, its performance, the technology and the different body gestures that can be used for creating successful gestures interfaces.

“Gesture-controlled user interfaces, what have we done and what’s next?”
Moniruzzaman Bhuiyan and Rich Picking
Centre for Applied Internet Research (CAIR)

This paper gives an overview of gesture-controlled interfaces in the last 30 years. Investigating different types of gestures, its users, applications, technology, issues addressed, results

and interfaces from existing research. This paper also provides research for gesture controlled devices for elderly or disabled people concluding that they need more technology using their natural behavior as a result the gesture base interface could be a good way to support them.

“Gestures, Cameras, and Projectors Combine for Smart Touchscreen Environments”
Gail Overton
Laser Focus World. April 29, 2013.
https://goo.gl/LR6rLD

This online article asserts the possibility of combining projectors with a gesture-recognition system in order to turn any surface into a touchscreen. He listed some researches that have been made about gesture recognition process, describing how these researchers have developed the recognition systems and suggesting that according to then, in the future there might be a possibility of interaction with systems in free spaces.

“PHOTONIC FRONTIERS: GESTURE RECOGNITION: Lasers bring gesture recognition to the home”
Jeff Hecht
Laser Focus World. January 25, 2011.
https://goo.gl/bjK59R

This article explores the Gesture-recognition technology using laser-based techniques, describing the basics and background, explaining how the infrared system works but also comparing different recognition systems that exist in the market describing their main use, and the potential market for this gesture recognition systems.

“Hand Gesture Recognition in Camera-Projector System. Attila Licsár and Tamás Szirányi”
In Computer Vision in Human-Computer Interaction.
Prague 2004.

A paper that describes the realization of a vision-based hand gesture recognition system, in order to create an augmented reality tool using camera-projector systems, it explains the functionality of the tool and the elements that influenced on the project, as a result this vision-based gesture recognition system and the camera-projector configuration proposed a natural way to control multimedia presentations or manipulate directly the projected image, a method that has been tested with significantly efficiency.

Video References

F 63.9 Maladie d'amour, Holographic Planetarium, Making of Bogdan Oliynik
2013. https://vimeo.com/84043137

this video is a holographic planetarium idea, that includes the process of making the graphics to the result of the piece.

Quantum Space / Interactive Room.
Sodazot
2015. https://vimeo.com/120944206.

Interactive video room/installation, based on a digital meditation. For Life Zone exhibition at M'ARS Gallery, Moscow.

Conductive Orchestra (Interactive Installation)
Ankkit Modi & Rudransh Mathur
Vimeo 2012. https://vimeo.com/40505337

Conductive Orchestra is an interactive installation that lets a user conduct / compose an electronic orchestra.

DESIGN PROCESS

Design Ideation

The ideation process came from the synthesis of the research and information collected throughout the development of the thesis since its proposal, and the use of different techniques in design to generate solutions.

The main goal was to create an installation experience that integrates experiential design, user experience (UX) and user interface (UI) methods with different technologies and game design dynamics. This provides an engaging interactive installation proposal that could potentially be found in museums, schools, universities and any educational or entertaining centers. The purpose would be to educate the user in astronaut training processes and astronomy education.

This installation involved experiential design and user interaction, using a gesture-based interface that gives the user complete control through projection.

Methodology

To develop an effective solution to this project, the applied methodology was based on the combination of elements of UX and UI with emphasis in user behavior toward the interaction with devices and interactive projections and experiential design. This explored design techniques and new technologies that involve projection design, installation design, environmental graphics and user interactivity with emphasis in gesture-based interfaces.

The content of the installation was an involving experience that included astronaut training challenges for mind and body preparation, shown through a series of tasks, guiding the user through the installation. In that sense, the information will be communicated in a more organized way. During initial thesis proposals, this project developed three challenges for the user to follow throughout the installation. In the future, however, the ideal installation will have multiple challenges with more information about astronaut training and the universe.

Target Audience

This project is mainly targeted to younger generations that are in the process of defining professional careers for their future, with the possibility of encouraging them to pursue astronomy or science and technology education. It could be for children age 10 and older and for adults and amateurs in the subject.

This project strived to communicate in an easy, understandable, entertaining way the process of training for astronauts both in body and mind preparation and elements of the universe. The goal is to inspire the user to continue exploring space to comprehend and learn from astronomy and its impact on society and encourage science literacy.

USER PERSONAS

Figure 1. User persona 1.
Created by Asierromero - Freepik.com

Sally Kingsburg

Demographics
Age: 12
Occupation: Student
Location: Rochester
Character: Quiet
Desired Career: Biology

“I like going to science museums to see different exhibits about science but my parents can’t take me often to the museum and I would like to know more about space”

Biography
Sally is a child who loves to read and do science experiments. She also cares about doing well in school. She would rather be indoors than outdoors. She is excited to take more science classes at school. She likes watching documentaries with her parents. *Planet Earth* is her favorite show.

Goals
Do well in School
Win the science fair at school

Tech skills
Internet 82%
Mobile Apps 75%
Social Media 60%

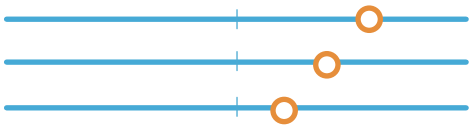

Figure 2. User persona 2.
Created by Pressfoto - Freepik.com

Elijah Soto

Demographics
Age: 11
Occupation: Student
Location: Baltimore
Character: Active
Desired Career: Undecided

“I love sports and games that make me think, especially brain games”

Biography
Joshua loves playing sports and making videos for social media, loves to play with his Rubik’s Cube and other types of mind-challenging games. His dad is a teacher and his mother is a stay-at-home mom. He does not know much about astronomy and astronauts but would like to learn about them.

Goals
To become a professional Baseball player

Tech skills
Internet 70%
Mobile Apps 75%
Social Media 40%

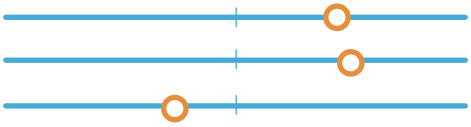

Figure 3. User persona 3.
Created by Freepik

Paul Dakota

Demographics
Age: 30
Occupation: Graphic Designer
Location: New York City
Character: Extrovert

“Being in the design world I like to keep up to date with technology, It helps me being more creative”

Biography
Paul plays guitar after work, loves to travel and visit new places. He’s technology driven and loves having the newest tech toys in the market. He’s very active and likes outdoor activities including biking, running and hiking. He likes museums but prefers the ones with more interactive exhibitions. His knowledge about science and space is basic but would like to learn more about them.

Goals
Travel around the world
He would like to incorporate his passion in design and technology

Tech skills
Internet 90%
Mobile Apps 95%
Social Media 80%

INFORMATION ARCHITECTURE

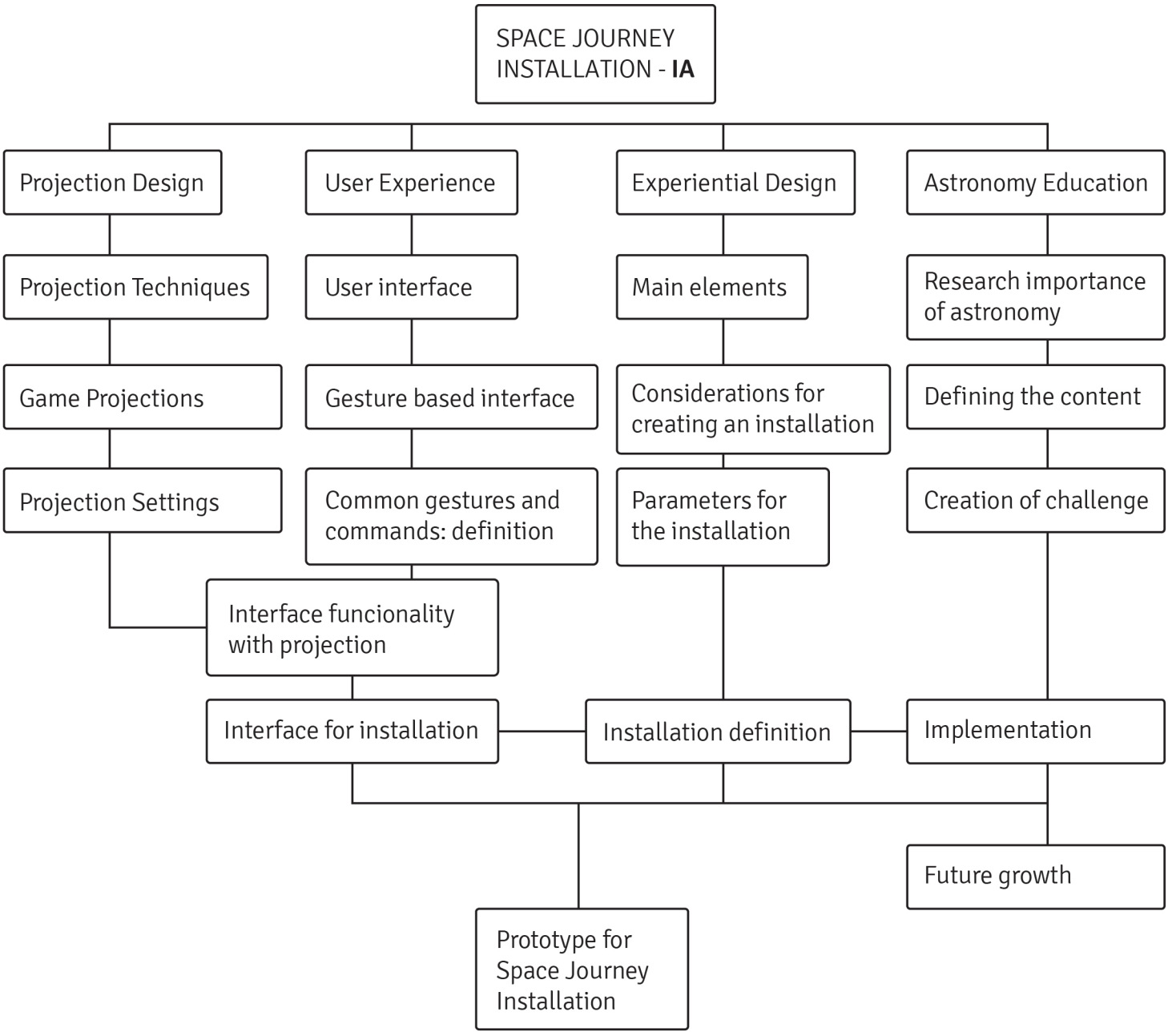

Figure 4. Information architecture flow chart

SPACE JOURNEY

Astronaut Training Program

The scope of this thesis project embraces a proposal of an installation that presents an interactive experience of a simulation of a series of mind and body challenges that resemble astronaut training in specific areas. In other words, each challenge was designed to develop physical and mental activities modeled after the real-life requirements of humans traveling in space with the possibility of broadening understanding of space elements and physical fitness.

Each challenge has its difficulty and the user will be guided throughout the experience. It is designed in a way that users simply follow along with the installation, streamlining the user experience. It starts by detecting the height of each user. The interface detects the user's height and places the display in a comfortable and reachable height to avoid body fatigue[1].

Following the experience, the user selects a mission. This is to assign an identification to the user and is created to resemble astronaut missions. After it explains the mind and body challenges, the user has the option to choose between play all the activities or select between a mind or body activity.

Each activity has its own purpose and rules. Throughout each of them, the user is presented with astronaut and space facts and information. After completing each game, the user gets rewarded with badges designed specifically for each game. There are multiple designs for each activity and every time the user plays again, he or she can earn a different one. This collection of badges has the purpose of becoming a keepsake for the installation that can be shared via social media for recognition, or as a physical patch for the user.

The main goal of the challenge is to create an astronaut training program with a series of small challenges to prepare the user for a space journey. The learning goals were to learn how to be an astronaut and important facts of their education and astronomy education that includes the solar system, planets, stars, and general celestial objects.

1. Huchel, Brian L. "Study researches 'gorilla arm' fatigue in mid-air computer usage." Study researches 'gorilla arm' fatigue in mid-air computer usage . May 8, 2017. Accessed October 6, 2017. https://www.purdue.edu/newsroom/releases/2017/Q2/study-researches-gorilla-arm-fatigue-in-mid-air-computer-usage.html.

ASTRONAUT TRAINING PROGRAM ACTIVITIES

BODY GAMES:

1- Speed of Light: Concentration and Reaction Time

The main goal of this challenge is to perform a physical activity that would improve quick decision making and reaction time.

The story of this game is that the Meteoroids (When a Meteor is orbiting space, it is called a Meteoroid. Once it enters Earth's atmosphere then it is called Meteor)[2] are traveling in direction of Earth and, if they aren't stopped, will collide with our planet. This activity consists of catching meteoroids quickly and redirecting their trajectory away from earth. The player must act quickly to move as many meteoroids as possible. The speed and volume of meteoroids increase throughout the game and the user can only miss two meteoroids. The game ends once the user misses his or her third meteoroid.

The results are displayed on the following screen, showing the number of meteoroids caught, the duration and the badge earned. The user can repeat the game to earn more badges, share the results online or continue to the following game.

NASA Fact[3]: *In preparation for space travel, astronauts invest many hours with NASA ASCRs and instructors to practice their hand-eye reaction time. Operating the robotic arm on the International Space Station (ISS) or landing the space shuttle requires crew members to have quick reaction times. Crew members must also be prepared for environmental hazards such as lighting and solar winds which could have a negative impact on reaction times.*

2. May, Sandra. "Meteoroid." NASA. July 21, 2015. Accessed October 10, 2017. https://www.nasa.gov/audience/forstudents/k-4/dictionary/Meteoroid.html.

3. Dunbar, Brian. "Train Like An Astronaut: Speed of Light." NASA. June 05, 2013. Accessed February 15, 2017. https://www.nasa.gov/audience/foreducators/trainlikeanastronaut/activities/SpeedofLight.html.

2- Control: Maintain your balance

The main goal is to perform a physical activity that would improve balance and spatial awareness.

The activity involves a spacewalk simulation. A spacewalk[4] is when the astronauts are outside of the International Space Station (ISS) or any vehicle while in space. They go out to perform different activities including science experiments and testing new equipment.

The game starts when the user, as an astronaut, finishes performing his or her job in space and must return to the spacecraft, avoiding obstacles and objects. The user moves around the ISS until finding the airlock and enters the spacecraft.

Using his or her body to move across the expedition, the user has a limited oxygen tank and must find the entrance of the ISS before running out of oxygen. The game ends when the player finds the entrance or when the tank runs out of oxygen.

The results are displayed on the following screen, showing the duration of the spacewalk, the oxygen tank level and the badge earned. The user can repeat the game to earn more badges, share the results online or continue to the following game.

NASA Fact[5]: *During the first few days of space flight and after returning to Earth, astronauts experience a change in spatial awareness and may lose some sense of balance when they return to Earth.*

4. Wild, Flint. “What Is a Spacewalk?” NASA. May 12, 2015. Accessed November 11, 2017. https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-a-spacewalk-k4.html.

5. Dunbar, Brian. “Mission: Control!” NASA. June 05, 2013. Accessed February 15, 2017. https://www.nasa.gov/audience/foreducators/trainlikeanastronaut/activities/MissionControl.html.

MIND GAME:

1_ Constellation Hunt: Search and identify Constellations and Stars

Behind every constellation there's a story. Constellations are useful for navigation and research in astronomy. People have used constellations for many different reasons which have changed throughout history. From religious purposes to agriculture and navigation, constellations have always been an interesting part of astronomy and general culture. They can be defined as a group of stars that form specific, recognizable patterns in the sky. The purpose of this challenge is to learn about names and location of constellation and stars.

The game consists of finding constellation on the starfield. The game is like a puzzle in which the user is given a specific constellation to find within a limited timeframe. He or she must find that constellation on the starfield by drawing lines between the stars. Every time the users finds the constellation, it gives a new one to find. If the user has difficulty finding the stars, the game give hints about the location of one star from the group. The game ends when the user fails to recognize the given constellation.

The results are displayed on the following screen, showing the amount of constellation founded, the duration time and the badge earned. The user can repeat the game to earn more badges, share the results online or continue to the following game.

GAMES PARAMETERS

The experience is designed as a single-player game, which means that only one user can play at a time. The nature of the single-player experience allows for a significantly greater range and depth of emotion and learning due to the independence it creates. The user can freely play and learn at his or her own speed and capability of understanding. It also gives the opportunity to better appreciate the information given and the graphic artwork.

Each challenge was created for the player to be prepared to become an astronaut by learning astronomy and how to train physically and mentally like astronauts. The core element is completing each activity to earn rewards, learn, and finish the experience.

REWARDS

The main gain of each challenge is learning to train like an astronaut and learning interesting facts about space.

There is badge reward system in which the user receives a badge for each challenge successfully completed. Every time a user plays again, they can earn a different badge per game and complete the collection of badges. This also works as a game keepsake where each badge can be physically acquired as a patch, or can be shared online for recognition. The user may also share the experience about the space journey installation.

Social media recognition, every reward could be shared online and in that sense, a ranking can be created for the user who achieves certain badges or completes the collection. Also, to share their experience with the Space Journey Installation.

USER FLOW

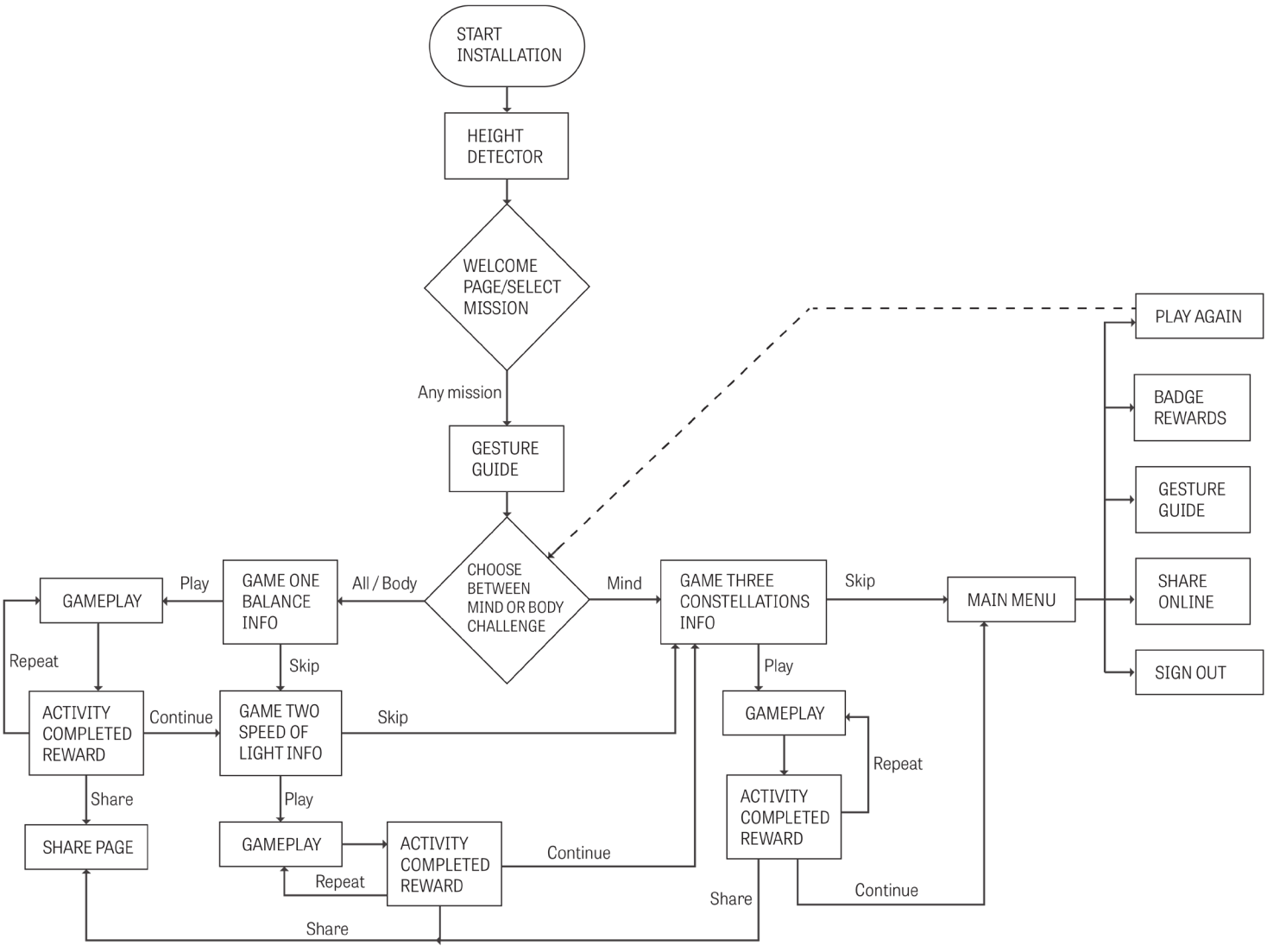

Figure 5. User flow chart

DESIGN INSTALLATION & TECHNOLOGY

The proposed setting for the installation involves multiple digital media platforms. With the intention of making an immersive experience, the installation consists of a 180-degree curved screen, made with projection mapping large enough to cover the entire and peripheral view of the user. The measurements proposed, as shown in the image 10, are 8 feet tall, 18.85 feet of surface area (curved, the screen surface is 12 feet from corner to corner). Its depth is 6 feet to leave enough space for the user to move comfortably and appreciate the entire screen while considering the main interaction area is the screen's center.

A motion detector or Kinect sensor is placed in front of the user to allow him or her to control the experience with hand and body gestures. The reason behind the use of a motion detector and a gesture-based interface is to develop an experience where the user has direct communication with the installation without the need of a specific handheld device, allowing him or her to fully concentrate in the experience without any distraction.

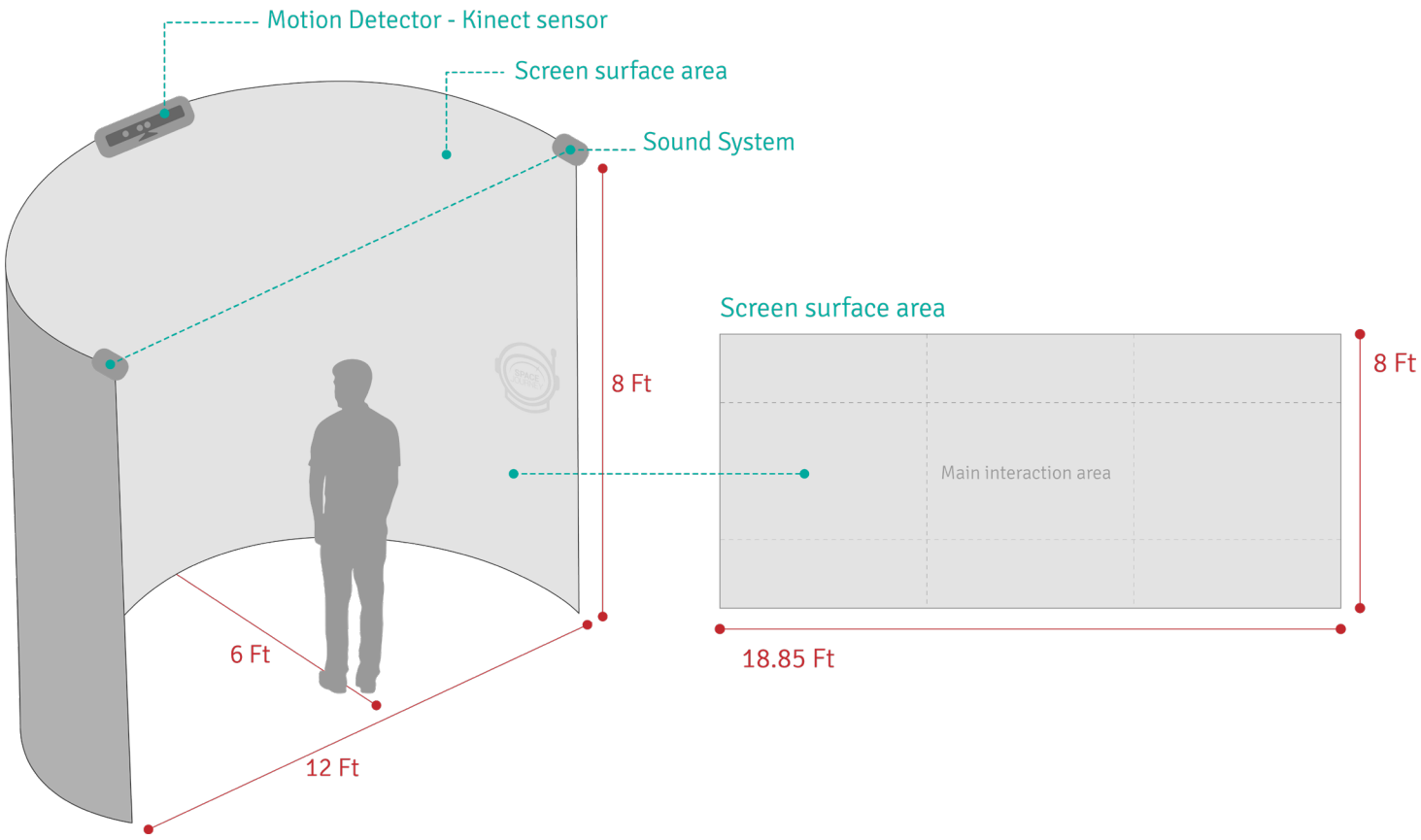

Figure 6. Installation mockup

Projection Mapping

Projection Mapping[6] is a technology in which projectors are placed and programed in specific ways to turn objects or surfaces into a display surfaces for video. The used of Projection Mapping for this thesis project is to allow the use of a curved surface and turn it into the display for the installation.

During research, it was determined that the type of projector suitable to be used for the installation is any projector that have 3000 lumens or more and 1920×1080 resolution approximately. In order to optimize resolutions in short distances, there are multiple types of projectors on the market with these characteristics.

Gesture-based Interface

Gestures are part of humans' nonverbal communication. Touchless Gesture Technology[7] has many advantages in terms of naturalness and freedom of expression, ease of learning, and the ability to influence existing dexterous skills. Many of them use cameras or sensors that read the user's movement to achieve a determined task, ideally allowing the user to focus his or her mind on the task without any distraction.

The possibility of controlling the installation with gestures also allows the user to have a sense of power and control when the interface responses to his or her commands, using the natural gesture language. This makes the experience more engaging with a feeling of personalization and independence.

The idea is to use a device or sensor that registers the dynamic hand motion to manage the projection on the installation, allowing the user to control it by using his or her natural language. This is much more intuitive and effortless compared to touching a screen, mouse or remote control. Gestures can create a comfortable user experience that strives to understand the human language in that way that sparks the next wave of electronic innovation.

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6. Jones, Brett. "What is projection mapping?" Projection Mapping Central. November 02, 2015. Accessed October 13, 2017. http://projection-mapping.org/whatis/.

7. Petty, John. "What is gesture recognition? Gesture recognition defined | Marxent." Marxent | Top Augmented Reality Apps Developer. May 27, 2014. Accessed November 10, 2016. https://www.marxentlabs.com/what-is-gesture-recognition-defined/.

Immersive Experience

A simple definition of an immersive experience[8] using technology can be expressed as the exposure of a certain engaging environment to change reality, within the space, to an alternative virtual space or reality. This is highly visual and involving.

Immersive experiences can create a sense of enhancing the world and it changes how people interact with it. Space Journey was developed to create an innovative digital experience in which the users are transported into a reality of an astronaut world and the universe. This allows them to focus on the experience, learn from it and enjoy it.

8. “Immersive Experiences.” Qualcomm. November 01, 2017. Accessed November 30, 2017. https://www.qualcomm.com/invention/cognitive-technologies/immersive-experiences.

INSTALLATION MOCKUP

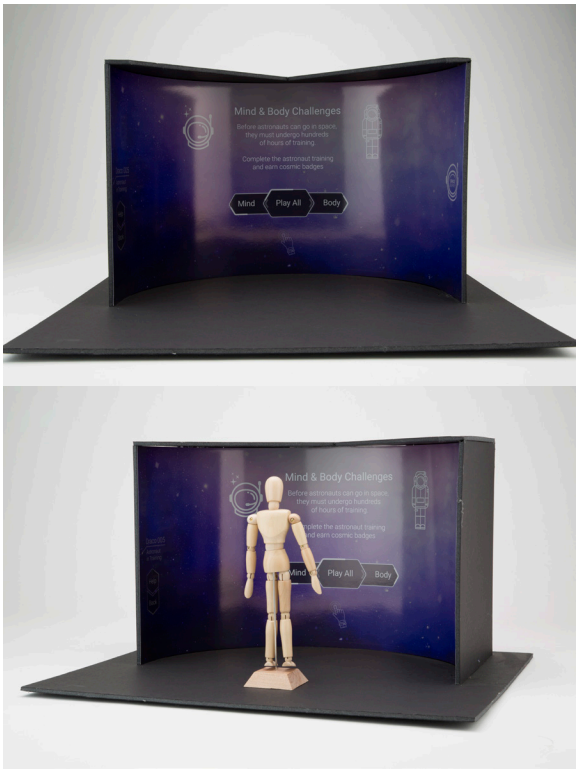


Figure 7. Views of physical Installation mockup

Figure 8. Views of physical Installation mockup

BRANDING

Visual Style

The key concepts for the visual style designed for space journey are technology and modernity. To convey these concepts and communicate the information given during the installation, the style design has a minimalistic approach with the use of vector graphics.

The look and feel of the installation were created with the intention of creating a space where the user has the ability to quickly understand the goals and requirements of each challenge in a clear, entertaining way.

Name: Space Journey

The naming process originated from the thesis proposal draft. The goal was to prepare the user for a space journey between the planets of the solar system, but it evolved into the astronaut training program, keeping in mind the goal of the preparation of astronauts that is a space journey.

At the same time, the name was created to give a sense of purpose to the user. This creates a vision for the future of space exploration.

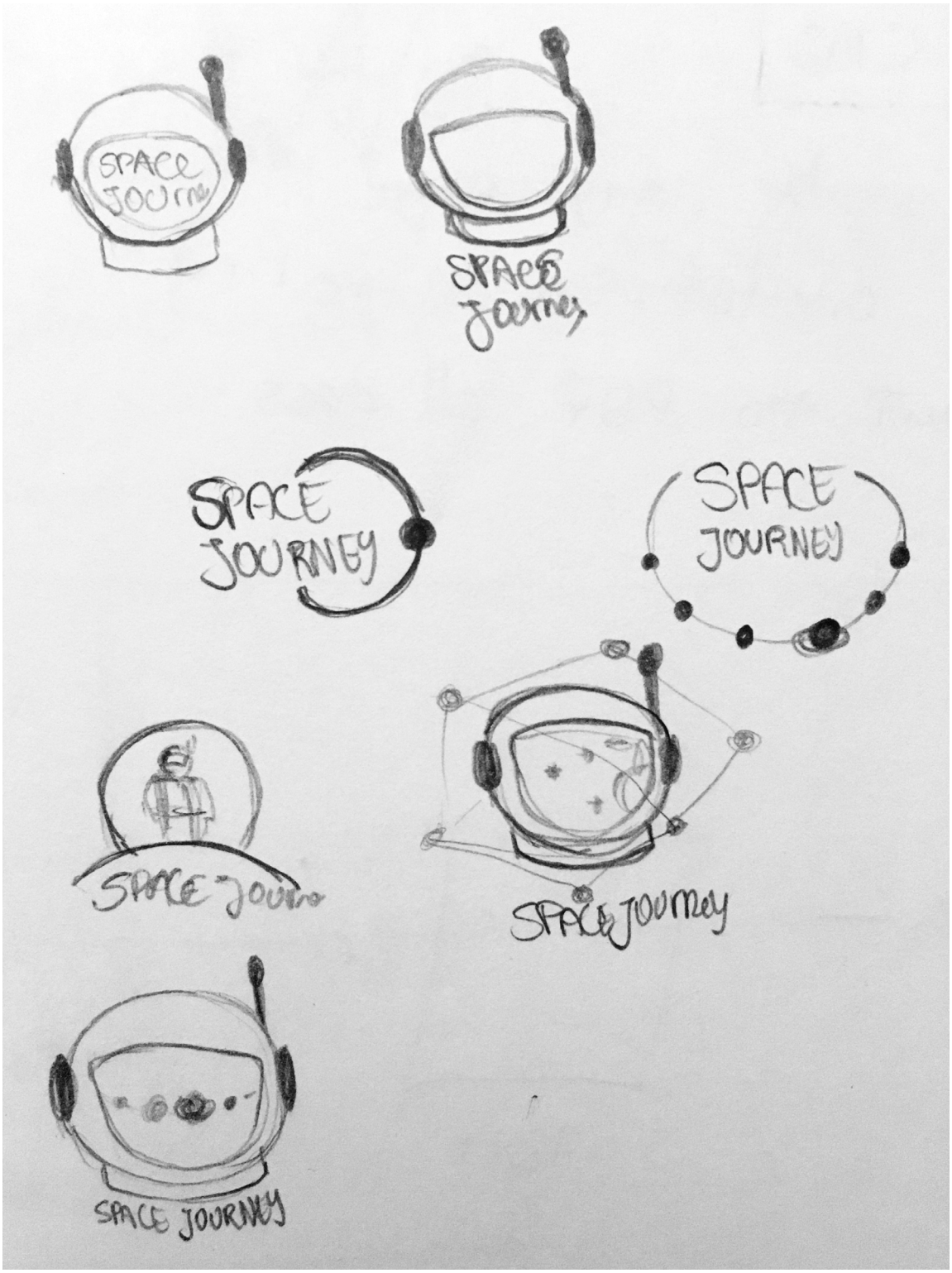
Logo

A logotype was needed to be attractive to both younger audiences and adults. The goal was to create a modern, attractive logo that reflects the purpose of the installation and the vision to the future, engaging to the user. Several drafts were made, resulting in the final logo

Logo Exploration

Initial ideas and sketches. Concept considerations that were explored included an astronaut helmet, planets and constellation shapes, representing the vision of the astronaut to the planets and space.

Figure 9. Initial sketches for the logo design.



Refined Explorations

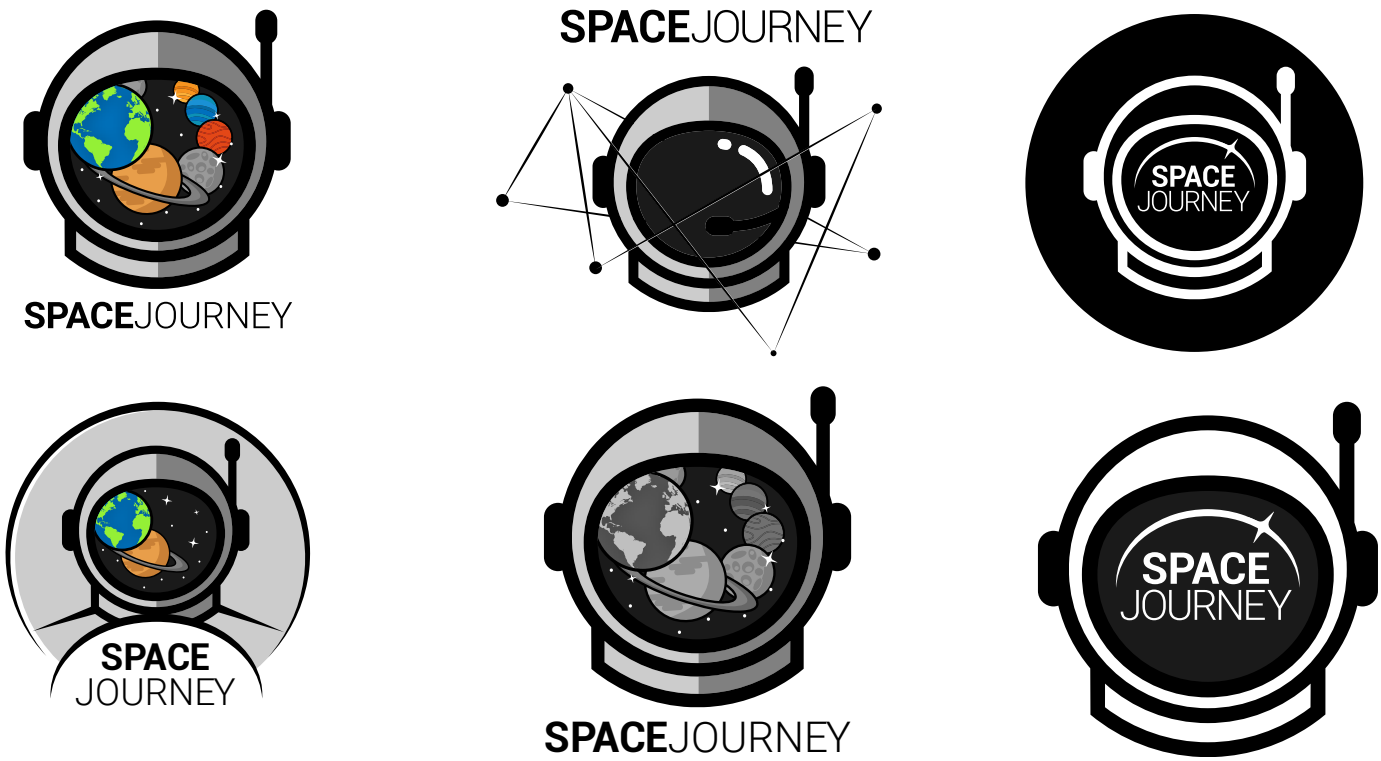
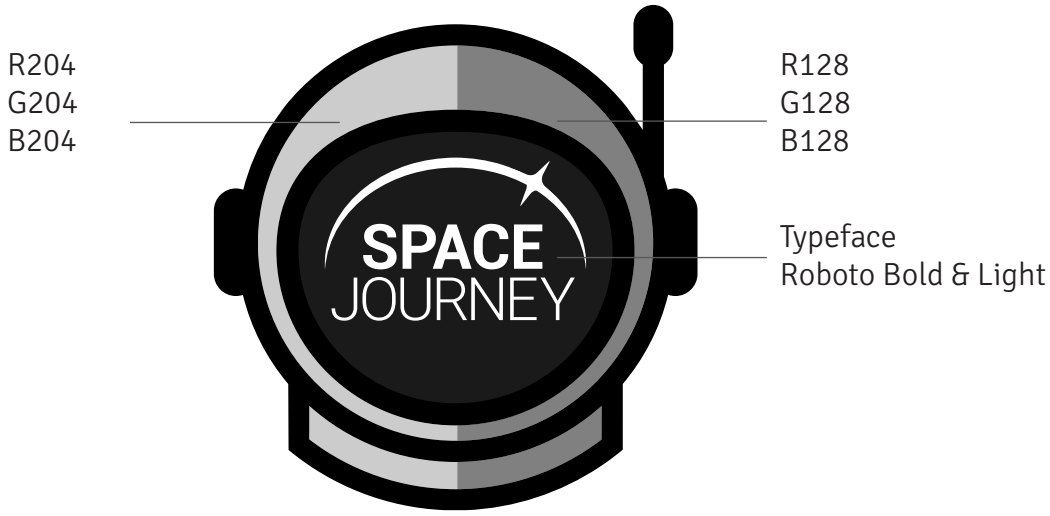


Figure 10. Refined explorations of the logo design.

Final Logo

Figure 10. Final logo



Typography

The selection of the typography was based on the concept of modernity and legibility for digital screens. A versatile typeface with multiple weights for the use throughout the installation and logo for consistency was chosen.

Roboto is a geometric sans-serif typeface designed by Christian Robertson and made available by Google for free. It has an extensive family of weights that range from thin to ultra-bold, making the family a very versatile and legible choice for the logo and installation.

Roboto Light
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890.:,;'"(!?)+-*/=

Roboto Medium
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890.:,;'"(!?)+-*/=

Roboto Regular
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890.:,;'"(!?)+-*/=

Roboto Bold
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890.:,;'"(!?)+-*/=

Color Scheme

The color scheme was inspired by the colors in photographs of the stars, nebulae and galaxies which have been provided by the International Space Station and the different space organizations.

RGB
153, 9, 34
HEX
990922

RGB
118, 16, 37
HEX
761025

RGB
98, 74, 116
HEX
614974

RGB
35, 89, 99
HEX
235963

RGB
53, 176, 181
HEX
35B0B5

RGB
119, 213, 89
HEX
77d559

Figure 11. nebulae and space images.
Source: http://www.colourlovers.com/blog/2008/05/06/colors-from-outer-space

Monochromatic palette with shades of gray

Black

RGB
128, 128, 128
HEX
808080

RGB
204, 204,204
HEX
CCCCCC

White

Iconography & Illustrations

The icons that compose the installation were design based on geometric forms, vector graphics style, and solid colors.

Several illustrations were created from simple shapes to more detailed style that sought to convey the essence of the message according to the section or context in which they were inserted.

The UI elements within the installation were simpler in style, with a sense of space and modernity to create the feeling of being in a futuristic space.

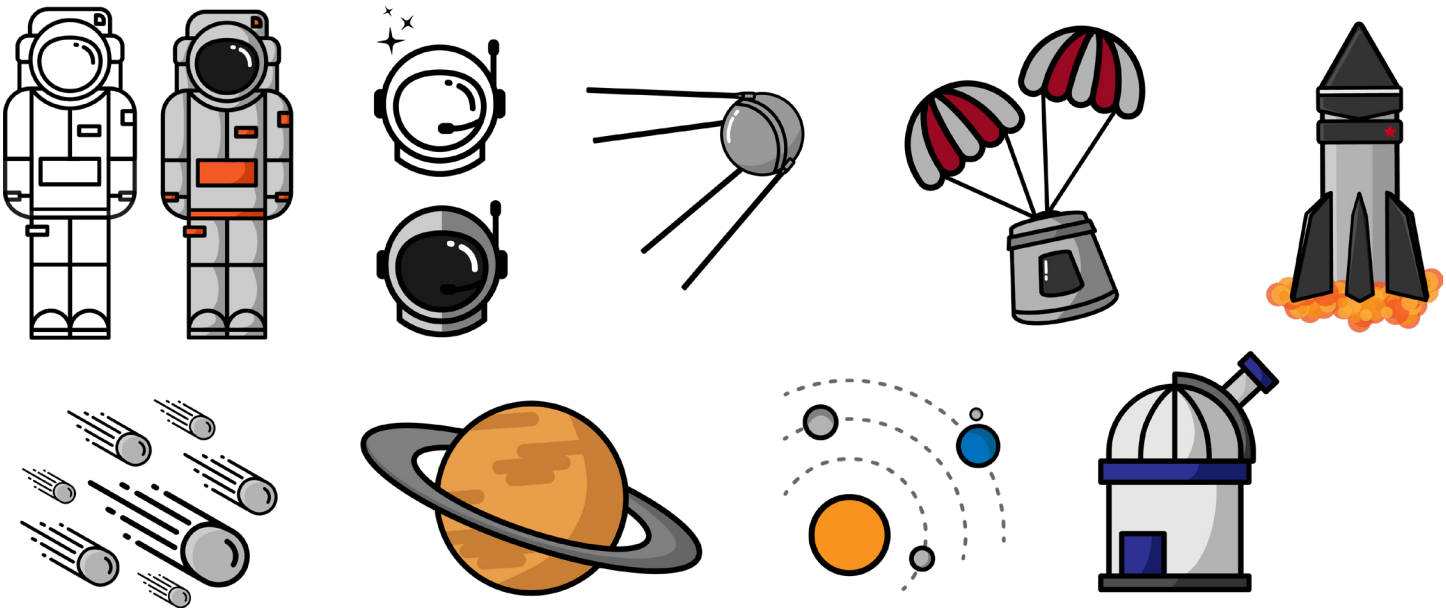


Figure 12. Based illustrations for Badge system and illustrations withing the installation

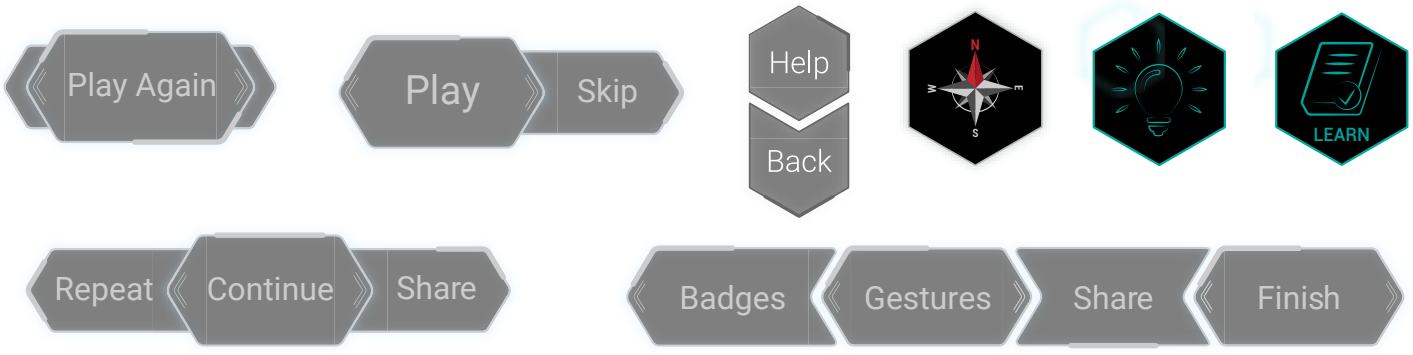


Figure 13. UI icons and elements for the installation

Badge Design System

A collection of badges was design for each individual game. Each game has its own specific color which is the unifying aspect for the multiple badges designed for each game. The elements illustrated in each badge have a correlation with the games' purposes.

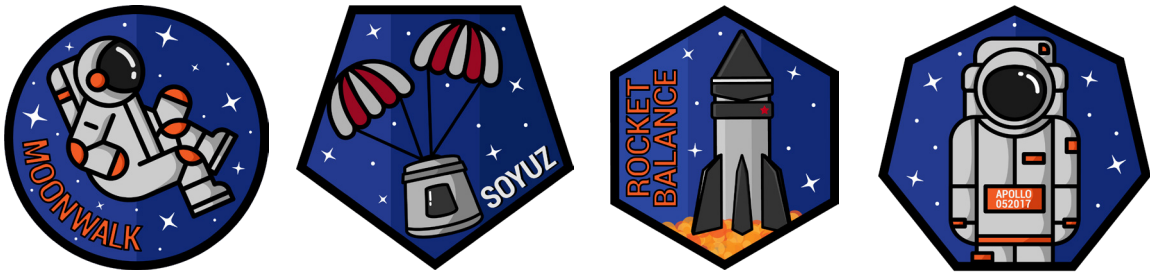
BODY GAMES:

1- Speed of Light

Figure 14. Badge design for Speed of light game

2- Control

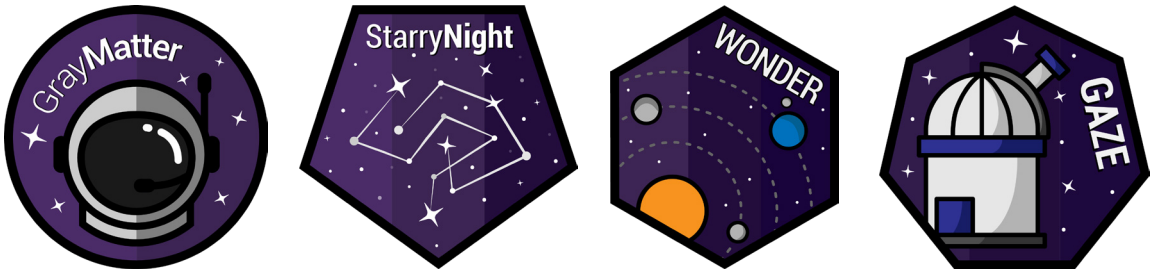
Figure 15. Badge design for Control game



MIND GAME:

1- Constellation Hunt

Figure 16. Badge design for Constellation hunt game



INSTALLATION UI STRUCTURE

The user interface of the installation was designed based on the position of the user, conformity, and ergonomics in design, taking in consideration the following:

- Interactive elements below or parallel to eye level to avoid neck pain on user
- Avoid user fatigue by using different types of short interactions
- Brief interactions with minimum effort
- Breaks after lengthy interactions
- Interactions that allow relaxed shoulders and elbows near torso
- Reduce simulation sickness and a syndrome called Gorilla Arm[9] that happens when someone who is using a vertical or standing touchscreen experiences fatigue and soreness due to an awkward and not very ergonomic positioning that is required.

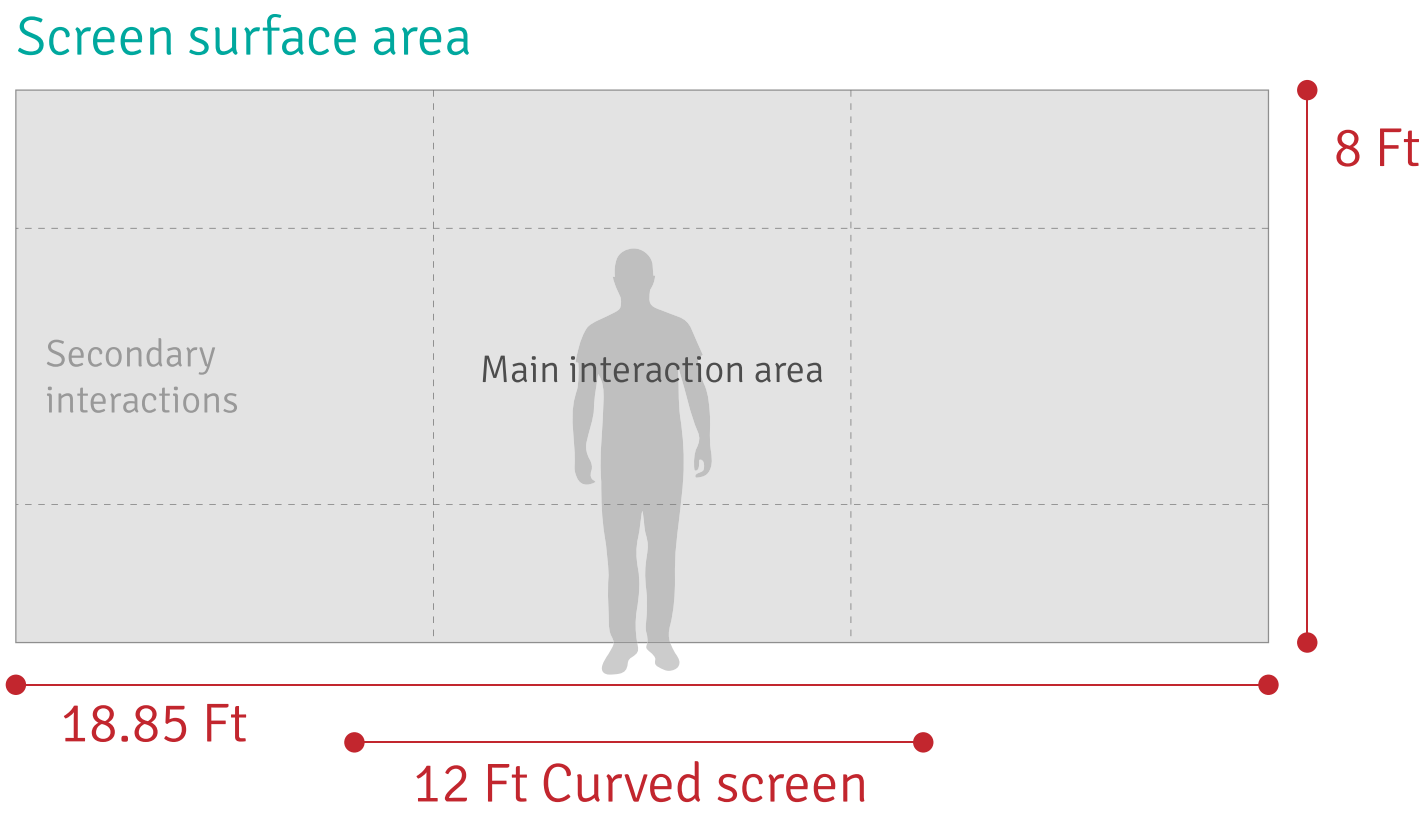


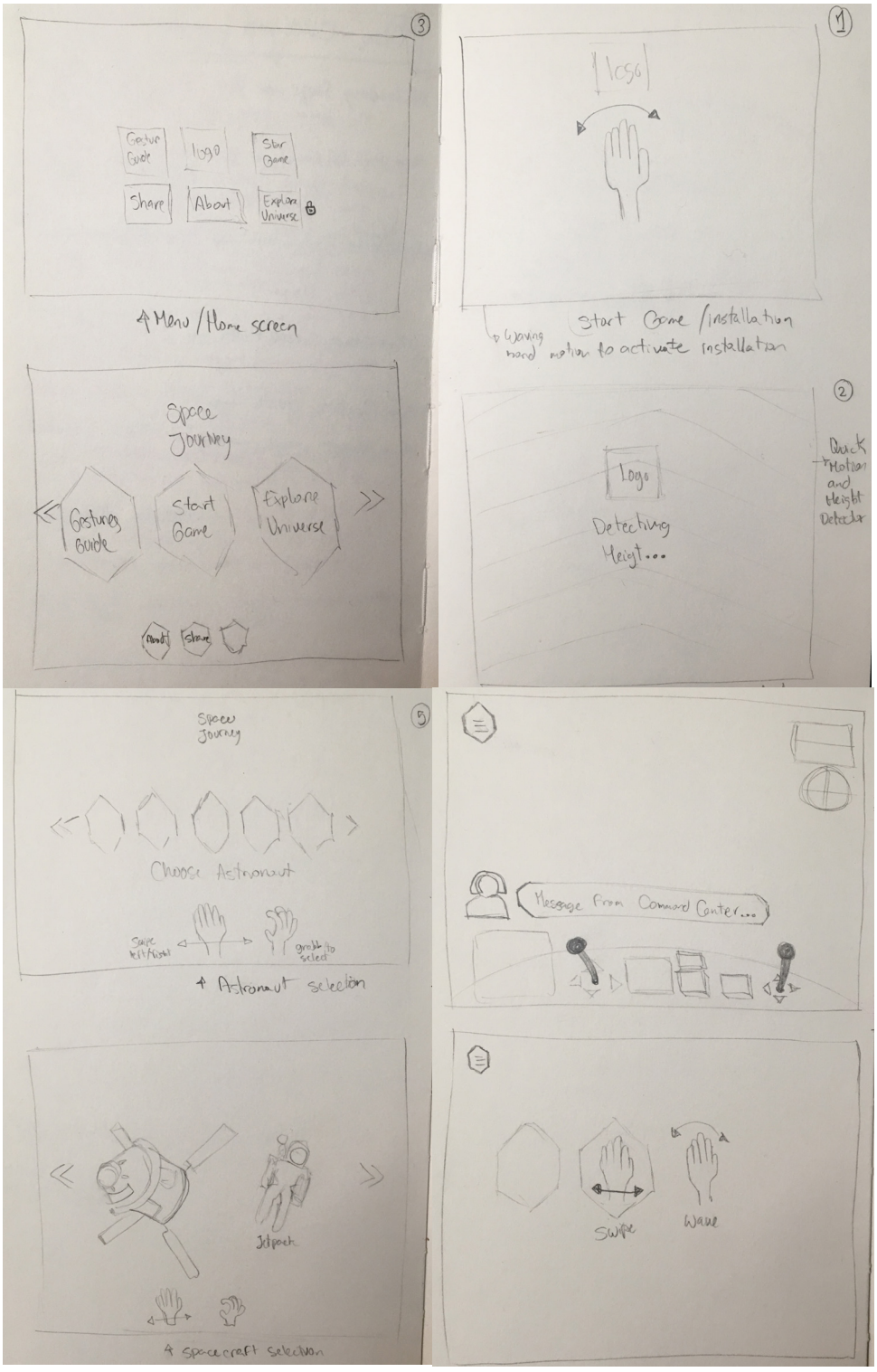
Figure 17. Screen structure

9. "Gorilla Arm." Techopedia.com. Accessed April 4, 2017. https://www.techopedia.com/definition/31480/gorilla-arm.

PAPER WIREFRAMES

Initially, the first round of wireframing was hand sketched to facilitate quick feedback in a timely manner and to start inquiring about the design system and the elements needed for the installation.

Figure 18. initial paper wireframes



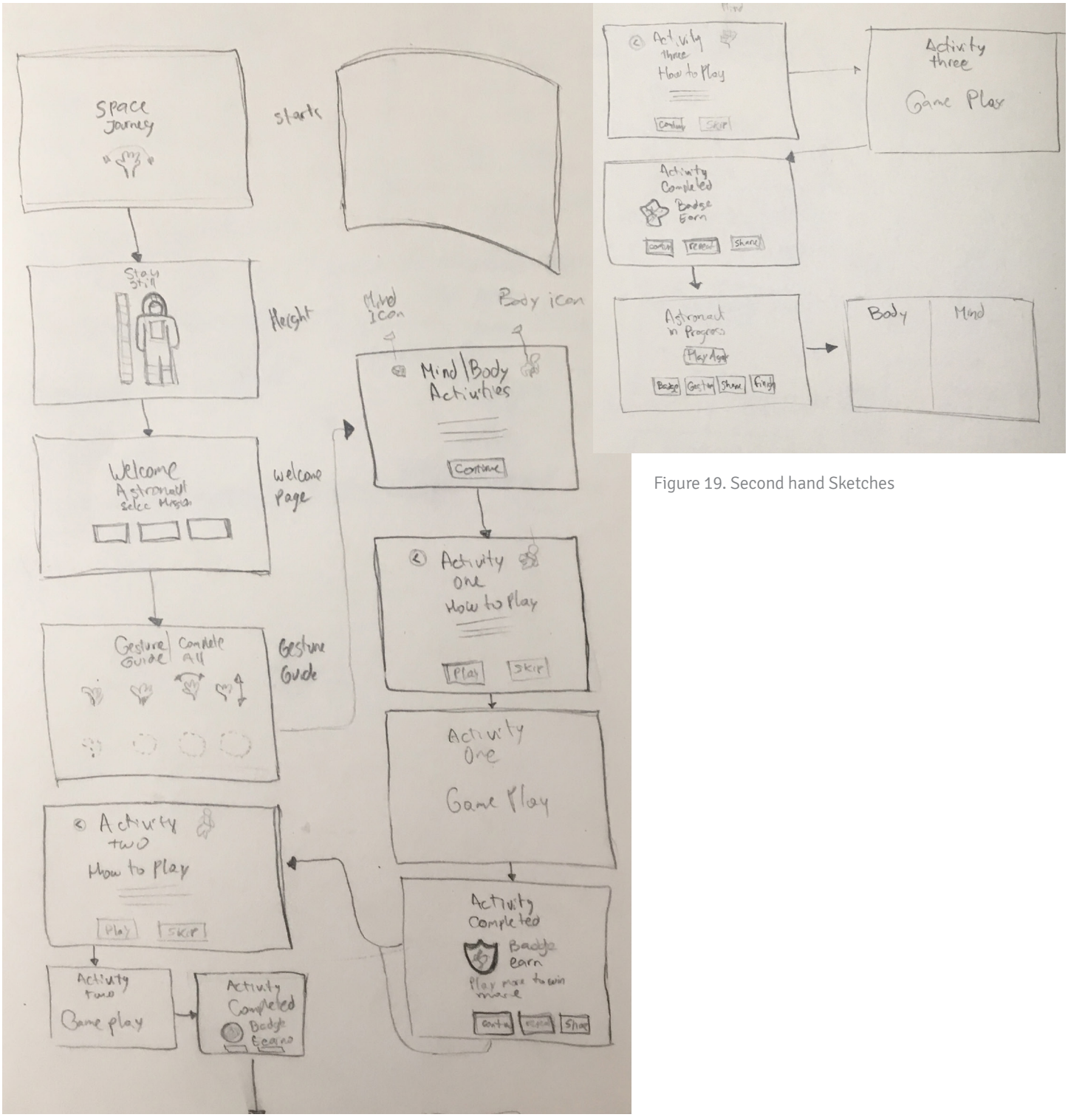


Figure 19. Second hand Sketches

LOW FIDELITY WIREFRAMES

After the paper wireframes, digital prototypes were developed and tested to collect user feedback on navigation and flow. As well as to start shaping the layout of the interface.

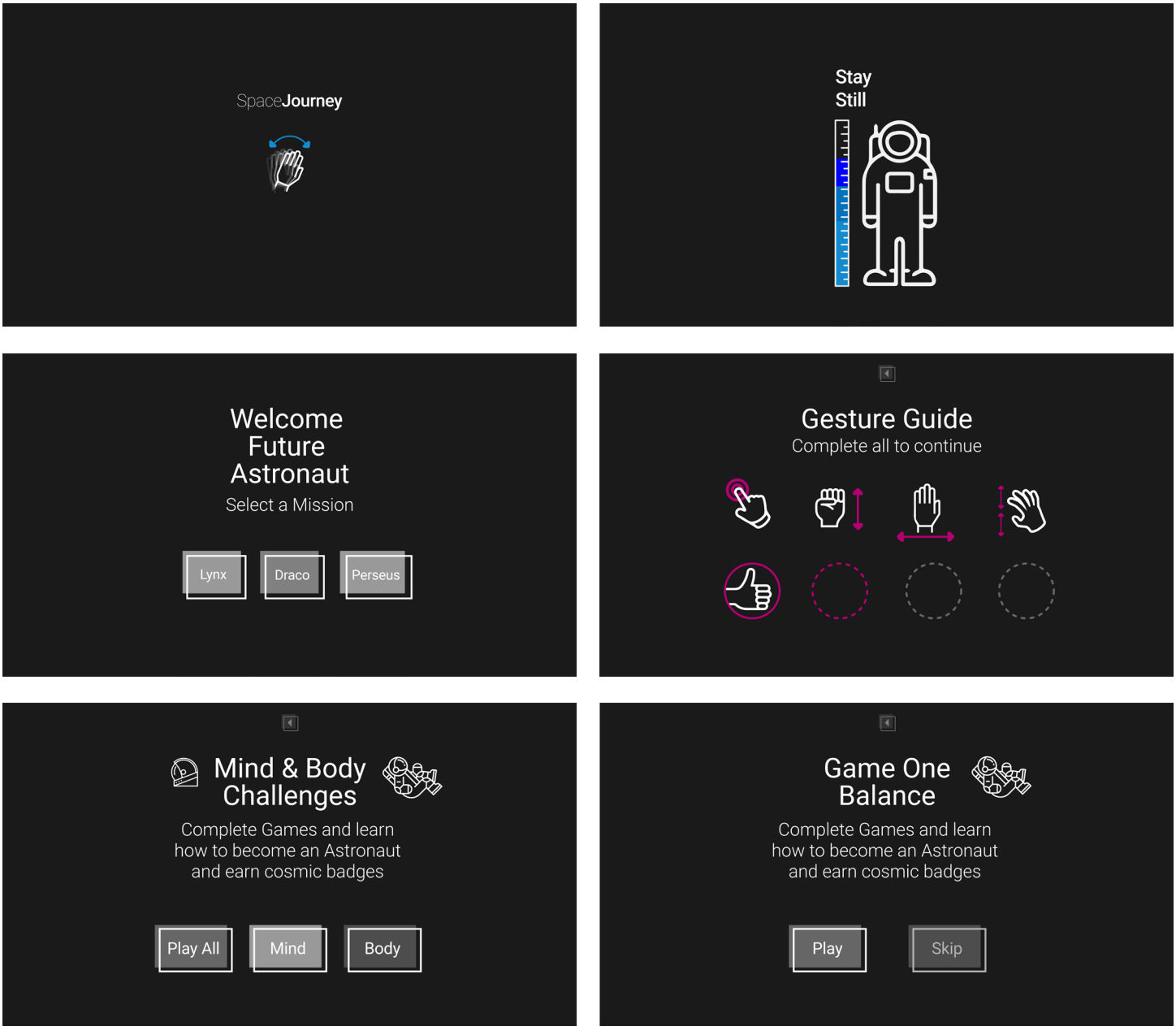


Figure 20. Lo-Fi wireframes

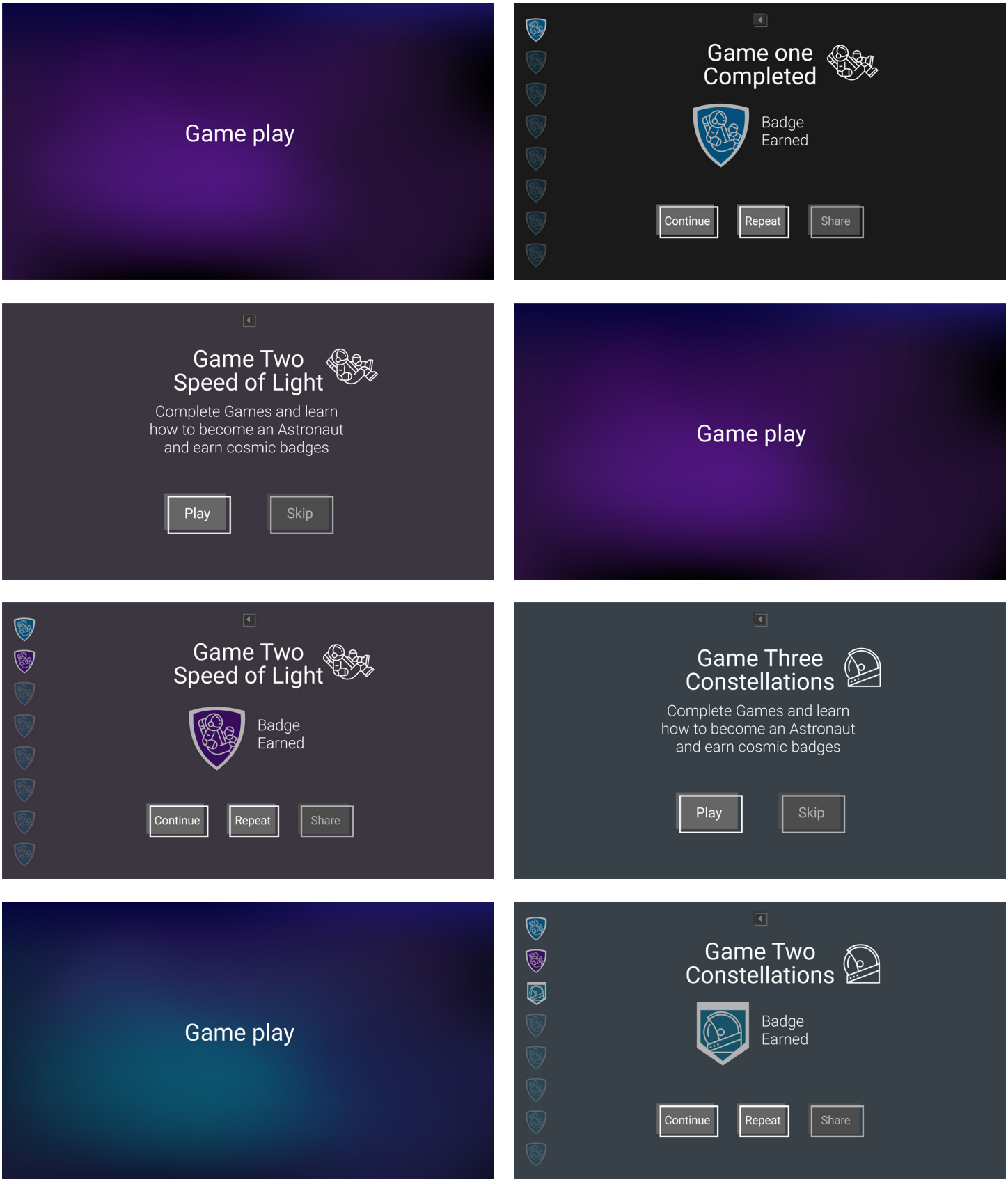


Figure 21. Lo-Fi wireframes continuation

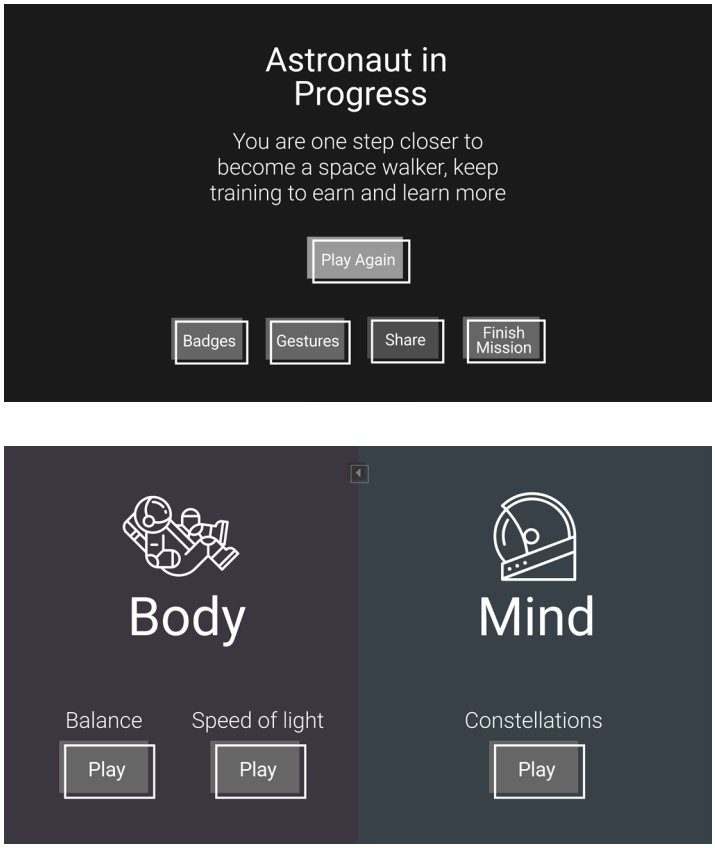


Figure 22. Lo-Fi wireframes continuation

USER TESTING

LO-FI WIREFRAMES FEEDBACK

The Low-fidelity wireframes were developed (Figures 20, 21 and 22) and user testing was conducted, the feedback was received through a combination of various discussions with additional designers and general users. The main content areas to be tested were the user flow, storytelling, challenges and gestures.

Feedback & Considerations:

- Show process of the user, astronaut in the end ready for the mission.
- More visual elements of how to play games and astronomy information
- less steps to start each challenge
- Gestures included in each challenge screens
- Minimal interfaces in the sides
- Motion to explain games instead of only text
- include Help button and Back button more visible.
- Good flow easy to navigate
- interesting initial icon style

User testing survey

Figure 23. Result of survey

1. The layout is effective and easy to navigate

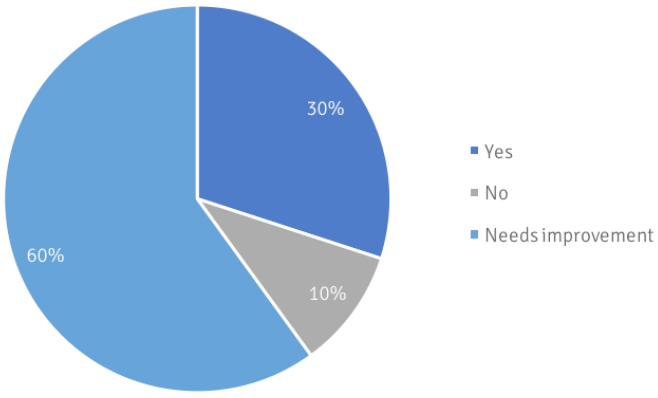
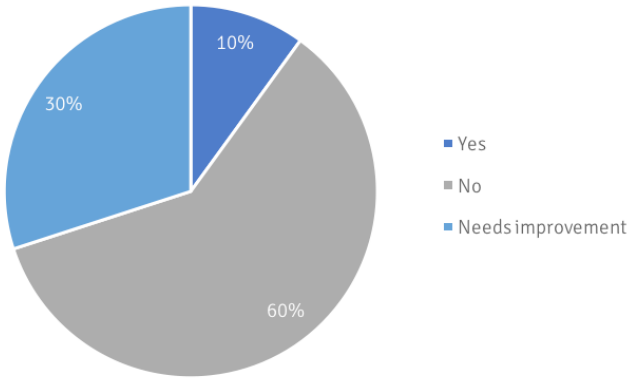
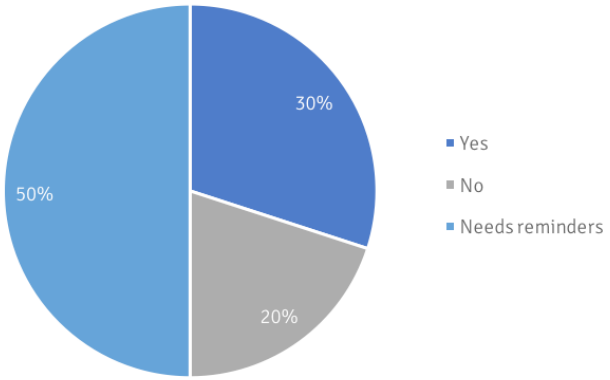


Figure 24. Result of survey

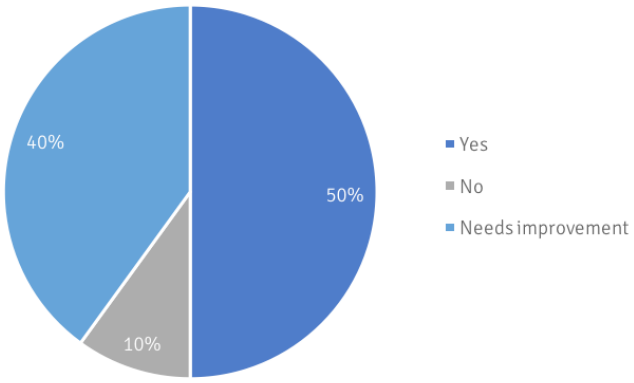
2. The amount of content is appropriate



3. Are gestures easy to understand and remember?



4. Buttons are clear to understand



FINAL APPLICATION

The process of this thesis took advantage of the Adobe Creative Cloud software (specifically Illustrator, Photoshop, and After Effects)

The high-fidelity prototype was created as a motion prototype to simulate the interactions and transitions of a working prototype and for a better understanding. The user testing was made by using still images of each screen.

Intro screen

When first encounter with the installation, the user should waive their hand towards the screen to activate. The ideal is that when the installation is not being used, it goes into a resting mode and to activate the user should waive their hand at it.

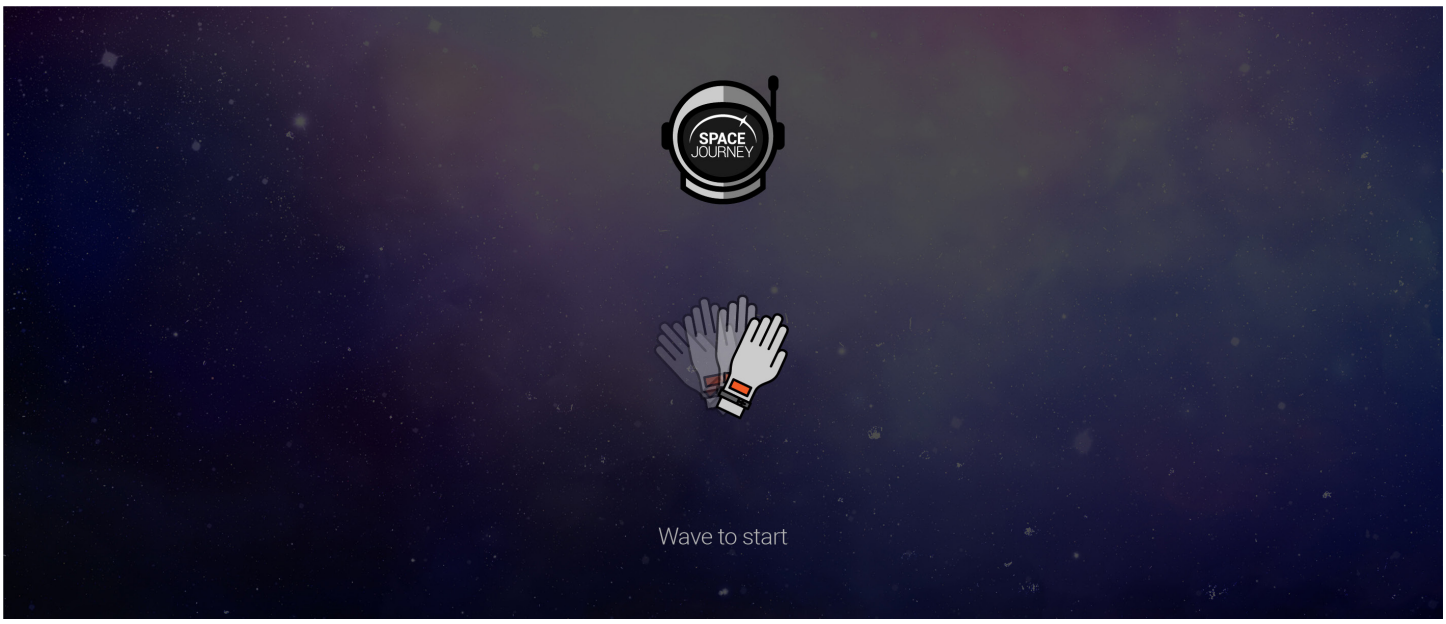


Figure 25. Intro screen

Height Detector

Before starting the challenge, the installation positions the interface approximately according to the user's height, the reasoning behind this is that the installation could be used not only by kids but adults as well and according to the ergonomics in design, if the interface is not approximately positioned to the user's eyesight, it could produce pain and unconformity.

Figure 26. Height detector screen

Welcome and mission selection

The first step to start the challenge is by deciding which mission the user would like to choose for the installation. By choosing a mission the user is given an identification creating a sense of belonging towards the mission. Using predefined missions, allow the user to choose rapidly without the need for input text and the number of steps to start the challenge is shortened.

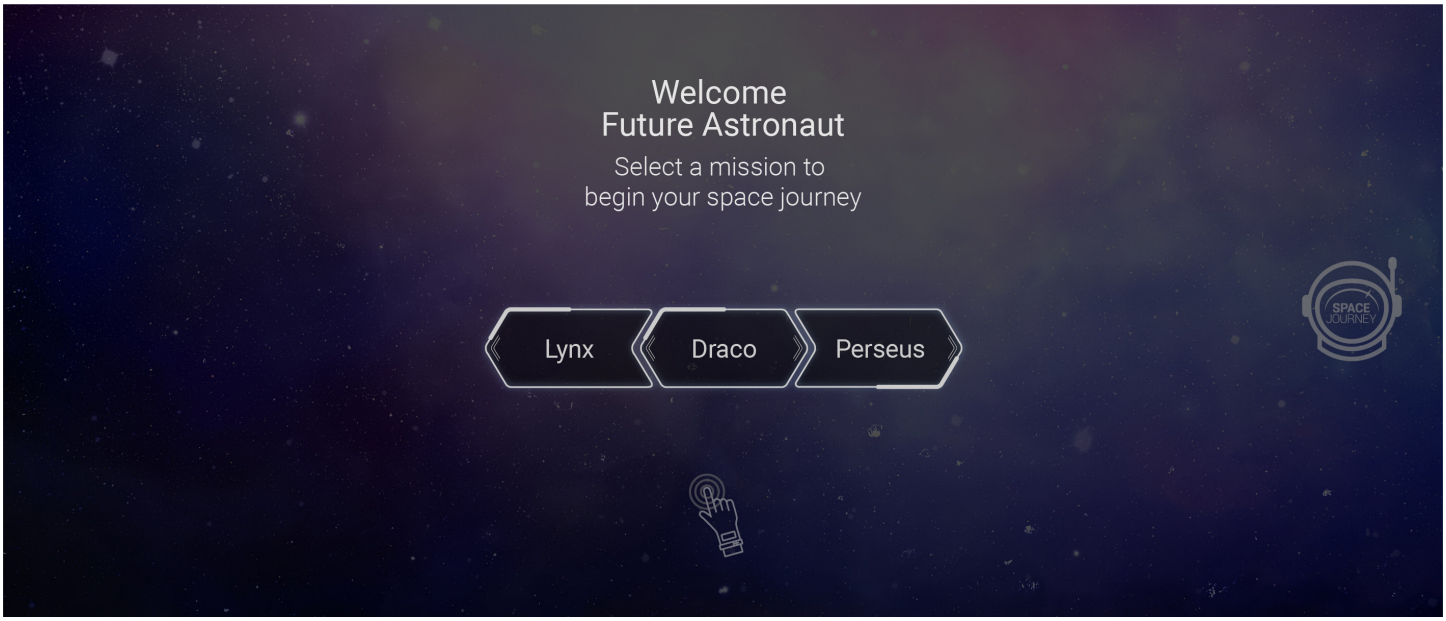


Figure 27. Welcome and mission selection screen

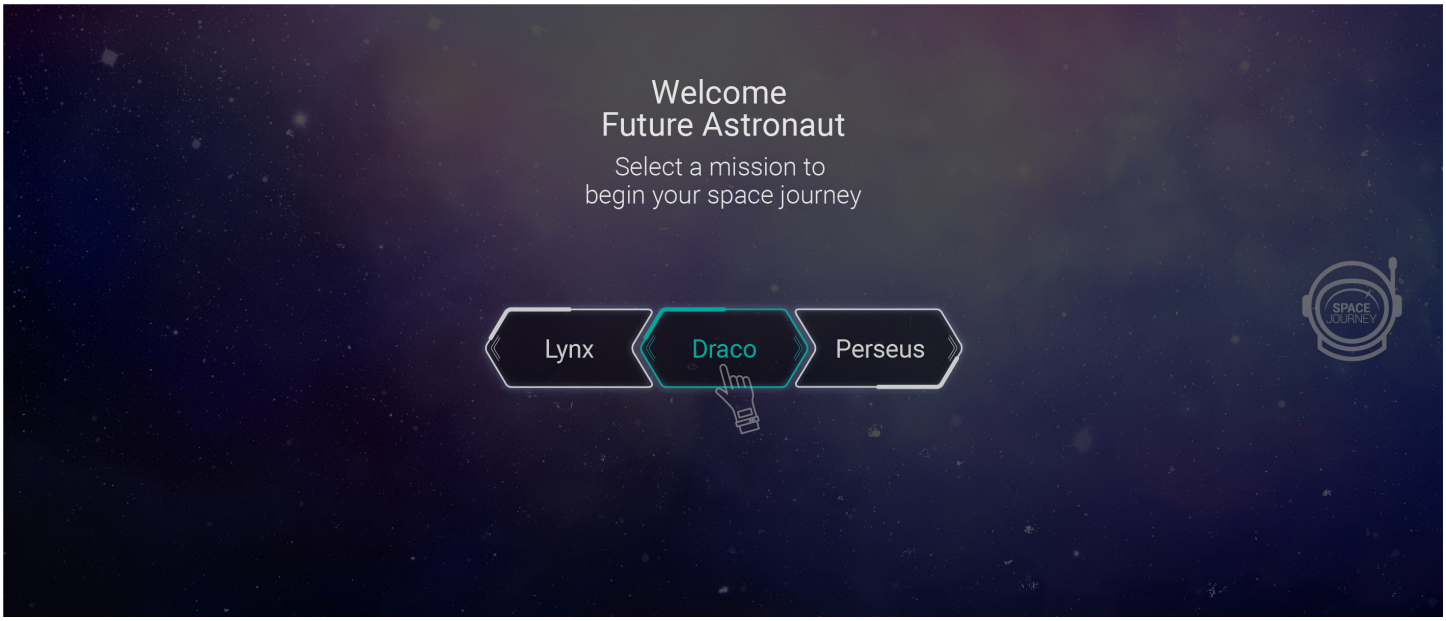


Figure 28. Welcome and mission selection screen

Challenges Dashboard

The main screen where the users can get information about the challenges, choose between “Mind”, “Body” or “Play All” buttons to start the challenges. Also it displays the secondary interaction in the left side where the users can check their status, game position, badges obtained, go back in the interface and get help.

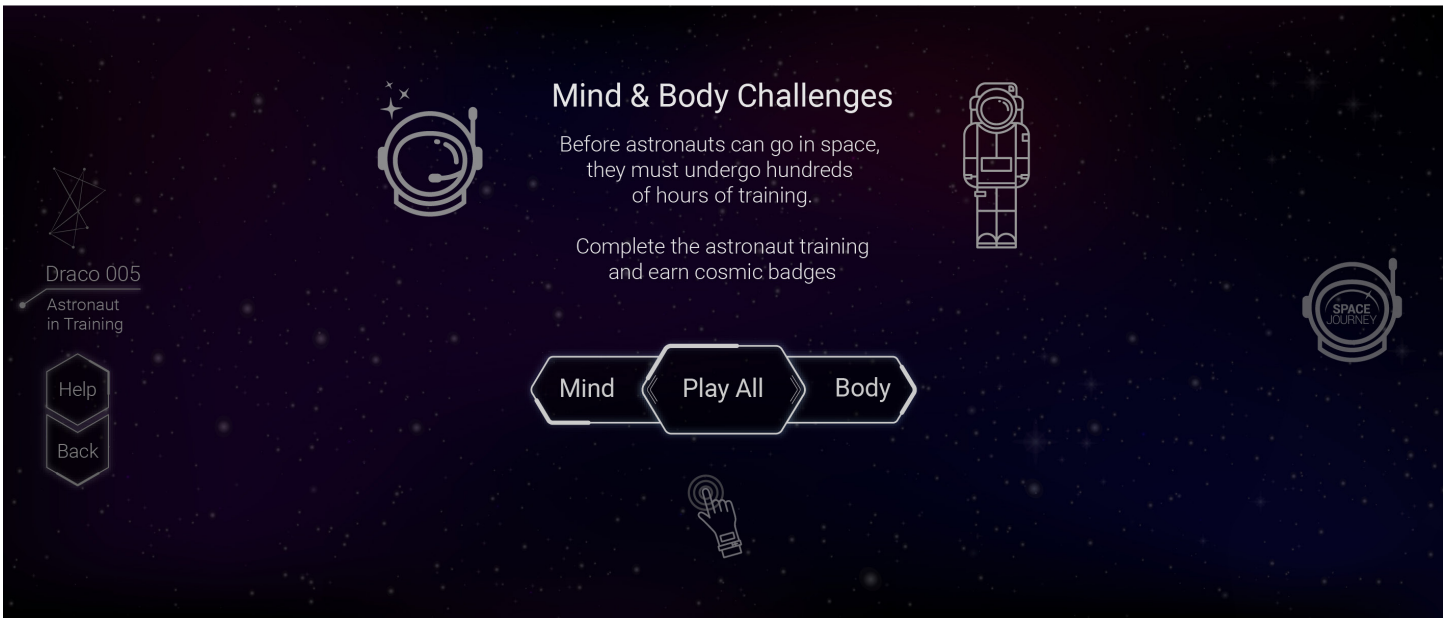


Figure 29. Challenges Dashboard screen

Body Game 1: Speed of Light

When “Play All” button is choosen, it starts with the body games, in the main game screen it displays the information about the game, an illustrated motion infographic about how to play. The possibility of skip the game is given to the users if they desired by choosing the “Skip” button.

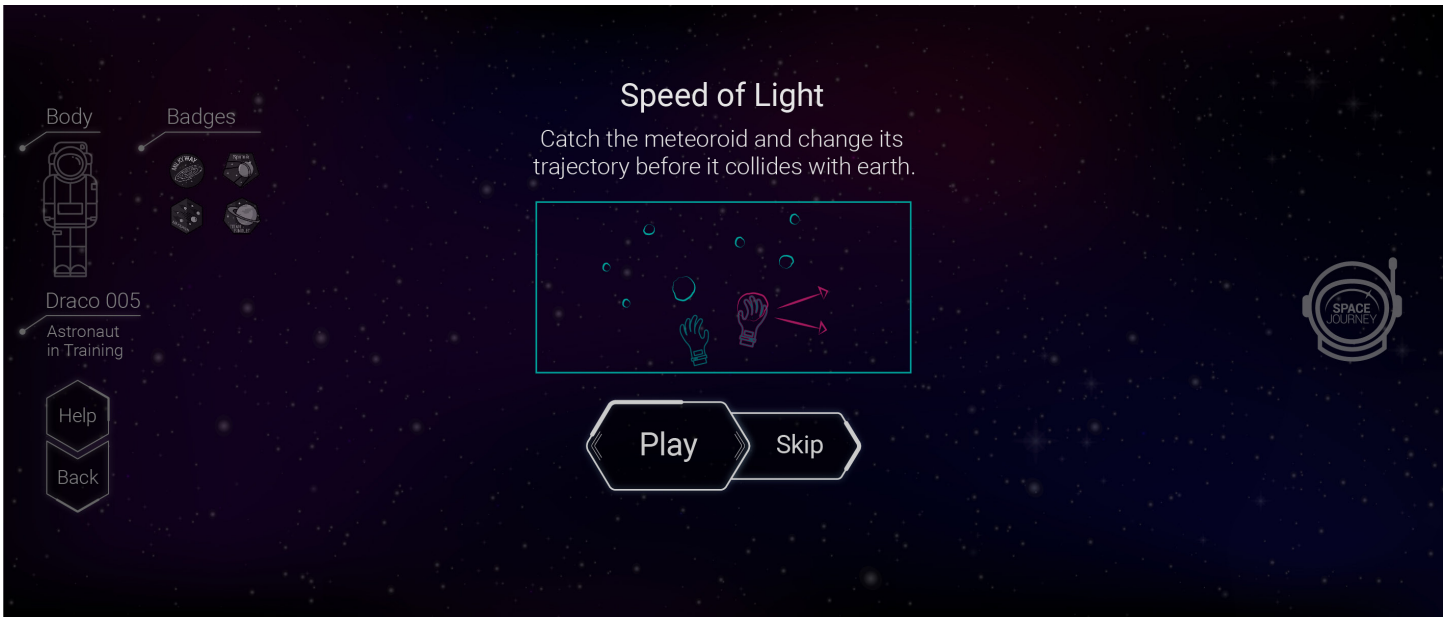


Figure 30. Speed of Light challenge screen

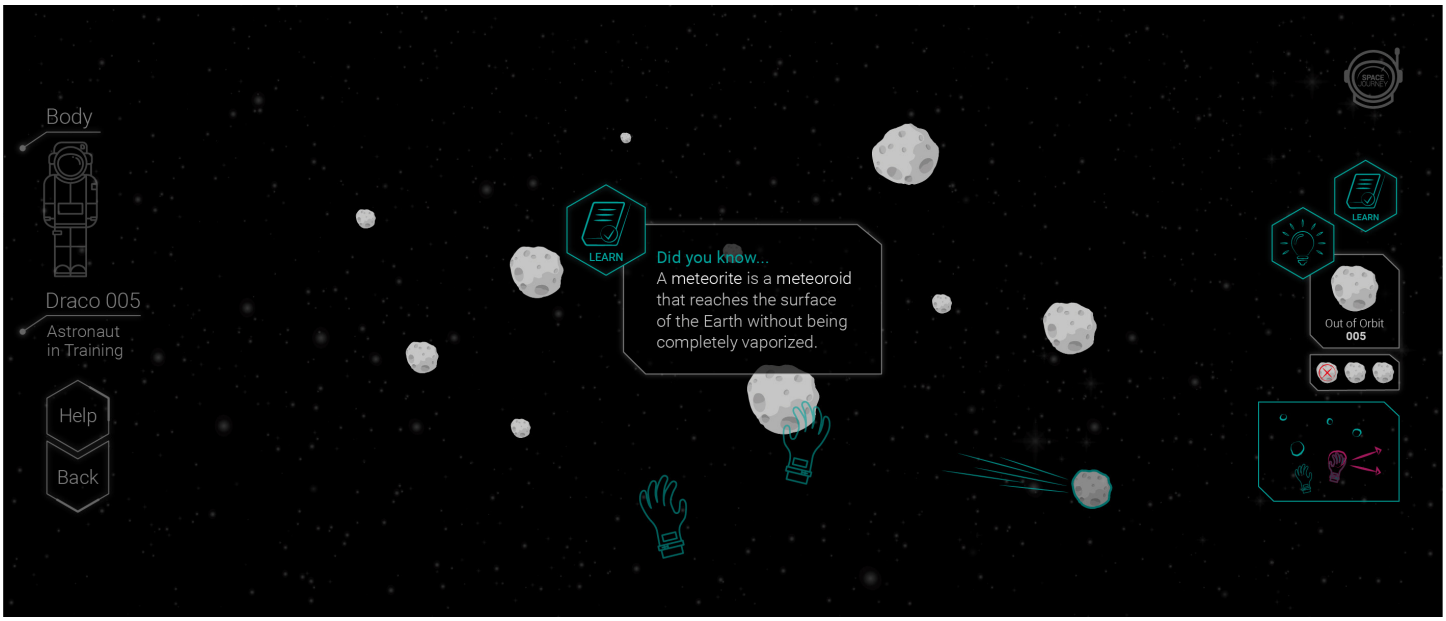


Figure 31. Speed of Light gameplay screen

Gameplay: initially it displays astronomic information regarding the game. It shows how to play, they meteoroids missed and a learning button to obtain more info and a hint buttons for help during the game.

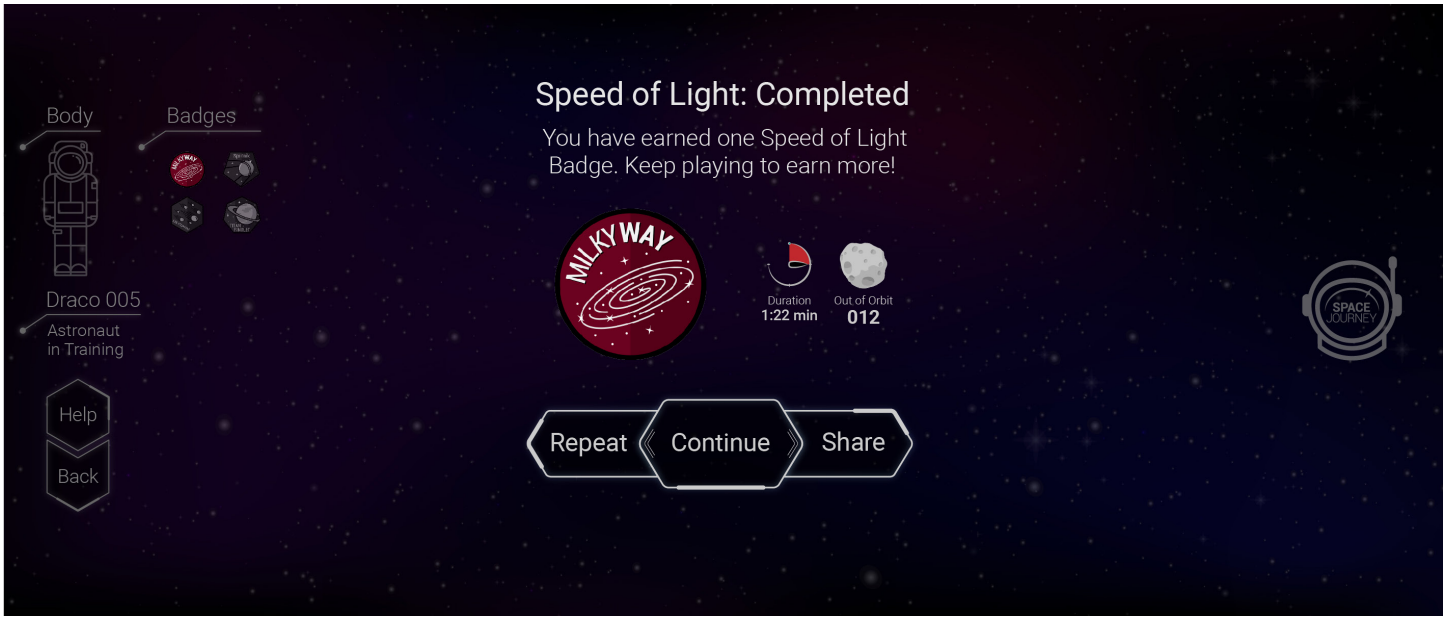


Figure 32. Speed of Light results screen

Game results: The final screen of the game, where the results are shown along with the badge earned. The user can choose to continue to the following game, repeat to have the possibility to earn more badges or share online for recognition.

Body Game 2: Control

The main game screen it displays the information about the game, an illustrated motion infographic about how to play. The possibility of skip the game is given to the users if they desired, by choosing the “Skip” button.

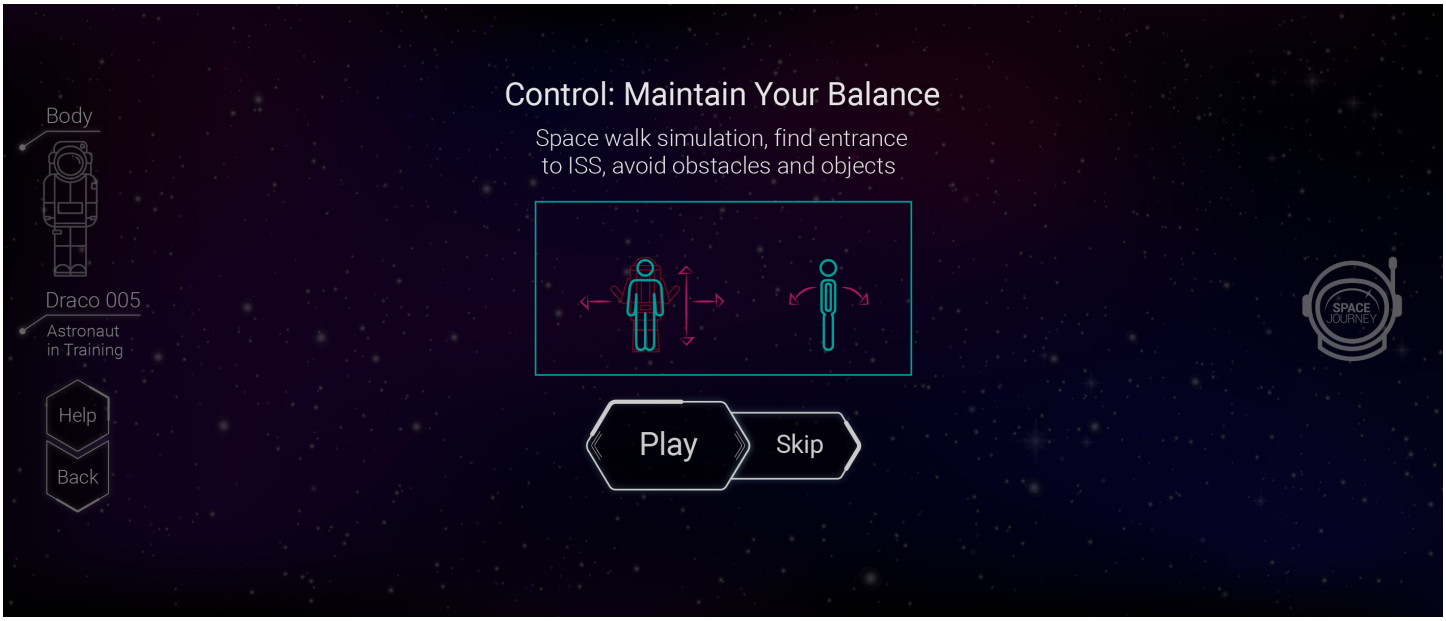


Figure 33. Control challenge screen

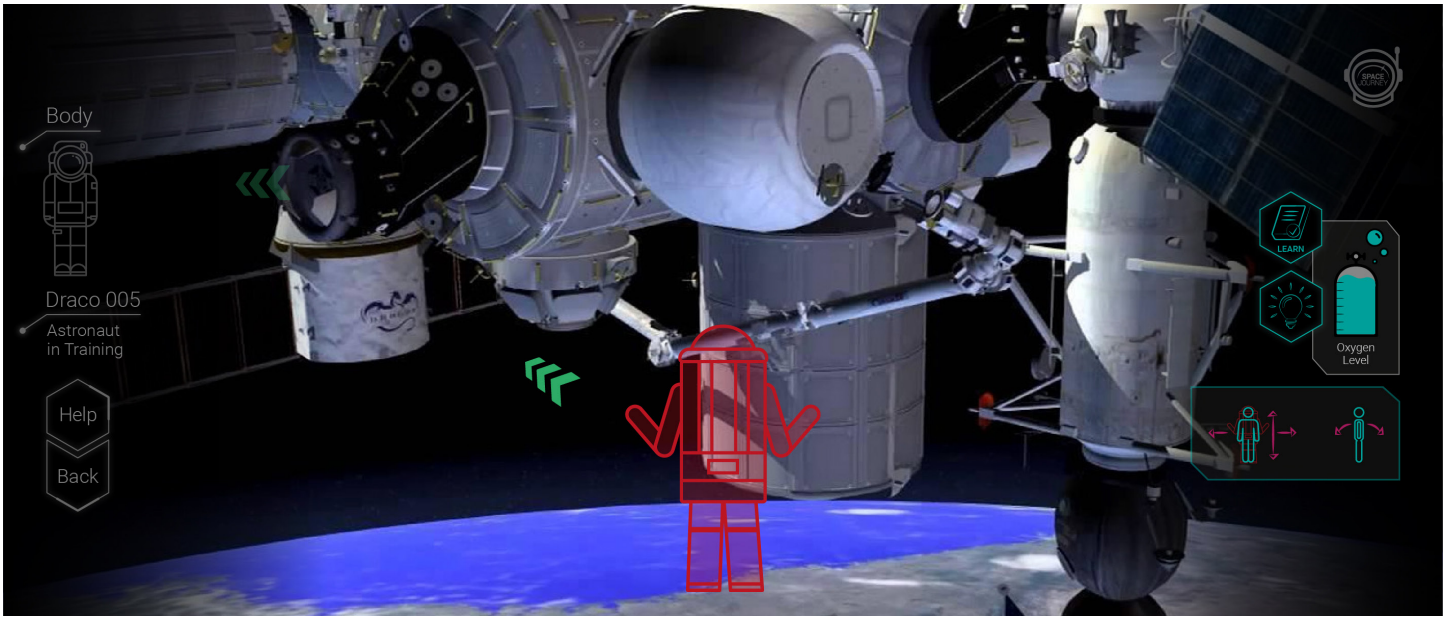


Figure 34. Control challenge gameplay screen

Gameplay: initially it displays astronomic information regarding the game. It shows how to play, the amount of time remaining expressed in oxygen level, a learning button to obtain more info and a hint buttons for help during the game.

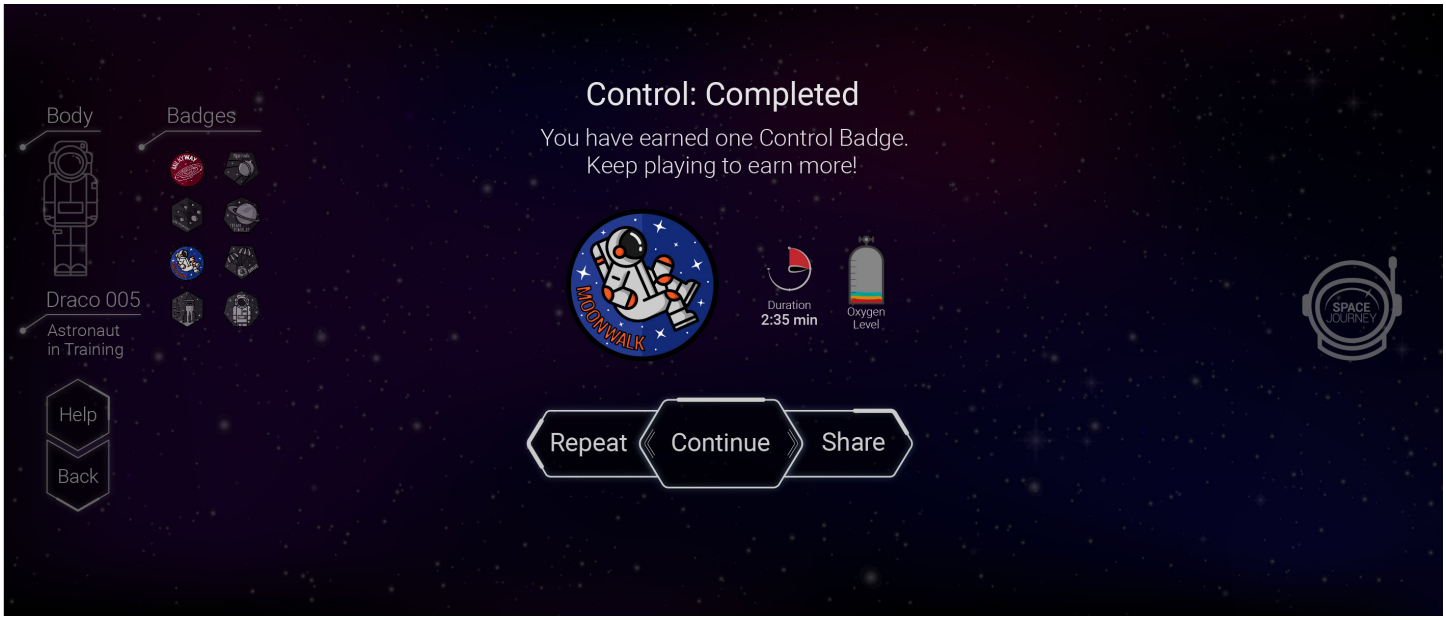


Figure 35. Control challenge results screen

Game results: The final screen of the game, where the results are shown along with the badge earned. The user can choose to continue to the following game, repeat to have the possibility to earn more badges or share online for recognition.

Mind Game 1: Constellation Hunt

In consistency with the other games, the main game screen displays the information about the game, an illustrated motion infographic about how to play. The possibility of skip the game is given to the users if they desired by choosing the “Skip” button.

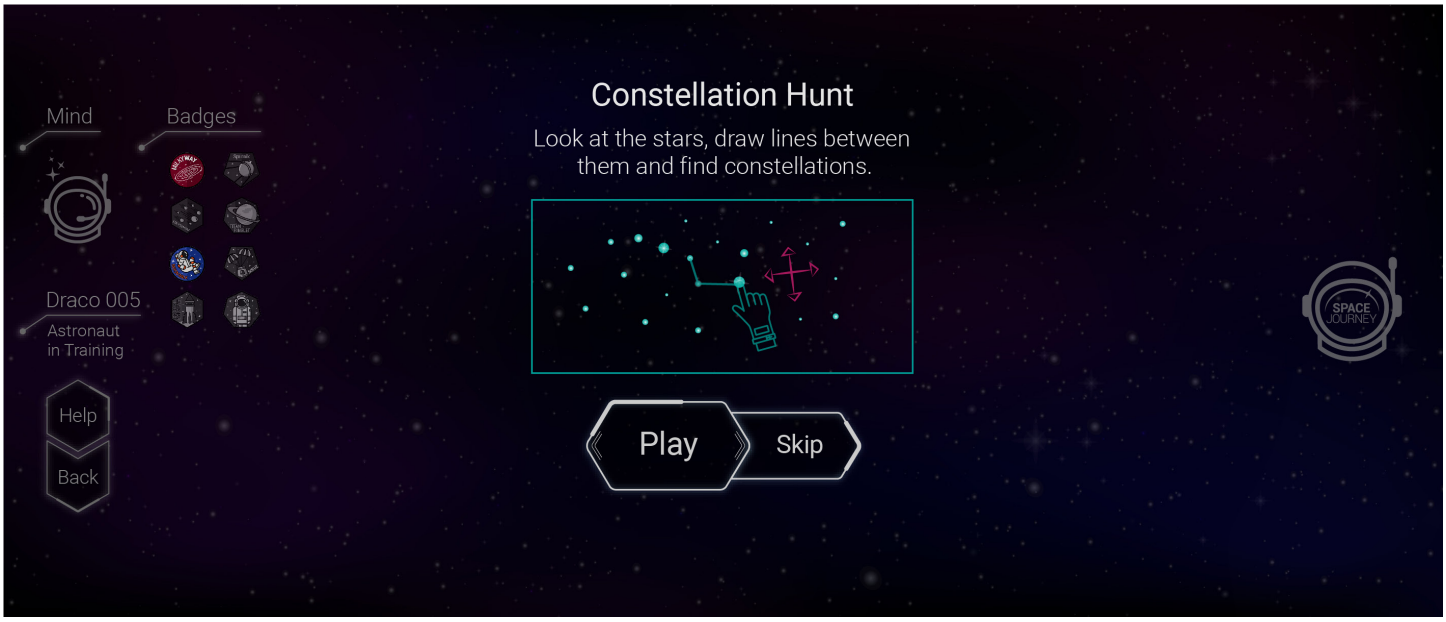


Figure 36. Constellation hunt challenge screen

Figure 37. Constellation hunt challenge gameplay screen

Gameplay: initially it displays the constellation that the user needs to find in the Starfield. It shows how to play, the amount of time remaining, the constellations found, a learning button to obtain more info and a hint buttons for help during the game.

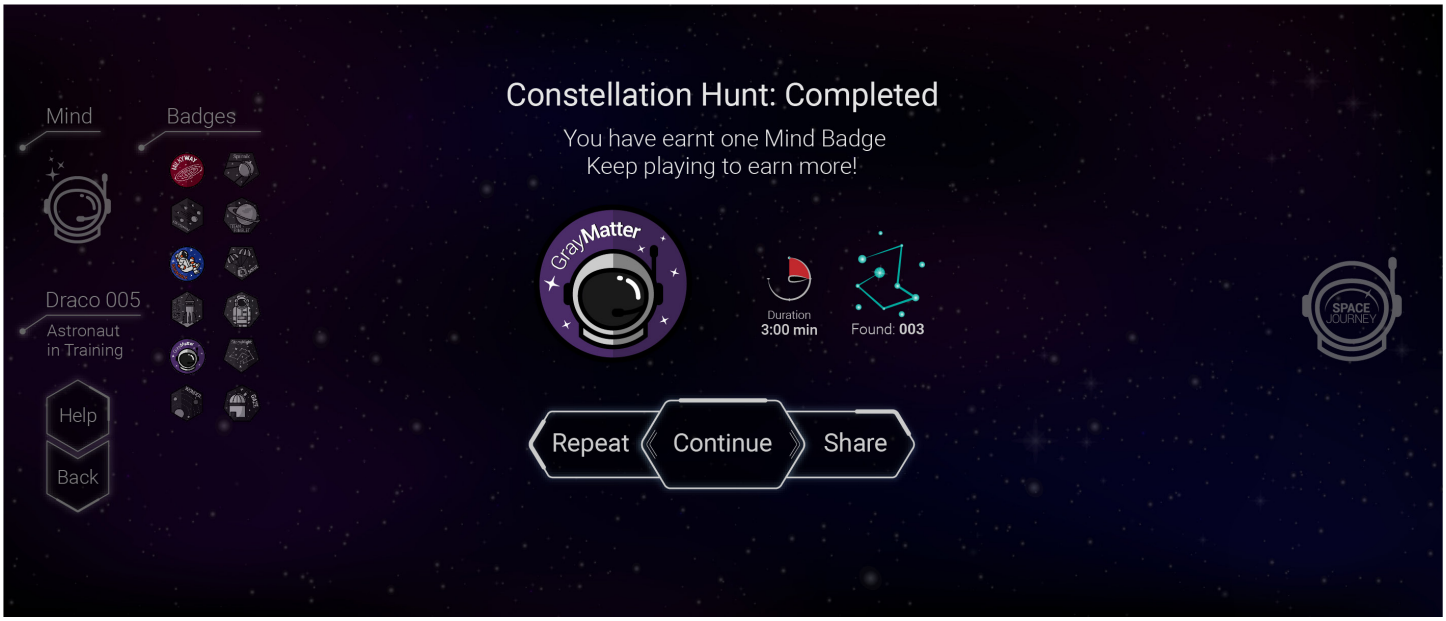


Figure 38. Constellation hunt challenge result screen

Game results: The final screen of the game, where the results are shown along with the badge earned. The user can choose to continue to the following game, repeat to have the possibility to earn more badges or share online for recognition.

Challenges Completed

After the games has been played, an overall result is displayed on this screen, finalizing the challenge and to incentivize the user to keep playing and share online

Figure 39. Challenges Completed screen

Challenges Completed 2

Following the overall results, another dashboard displays with multiple choices for the user to explore the installation beyond.

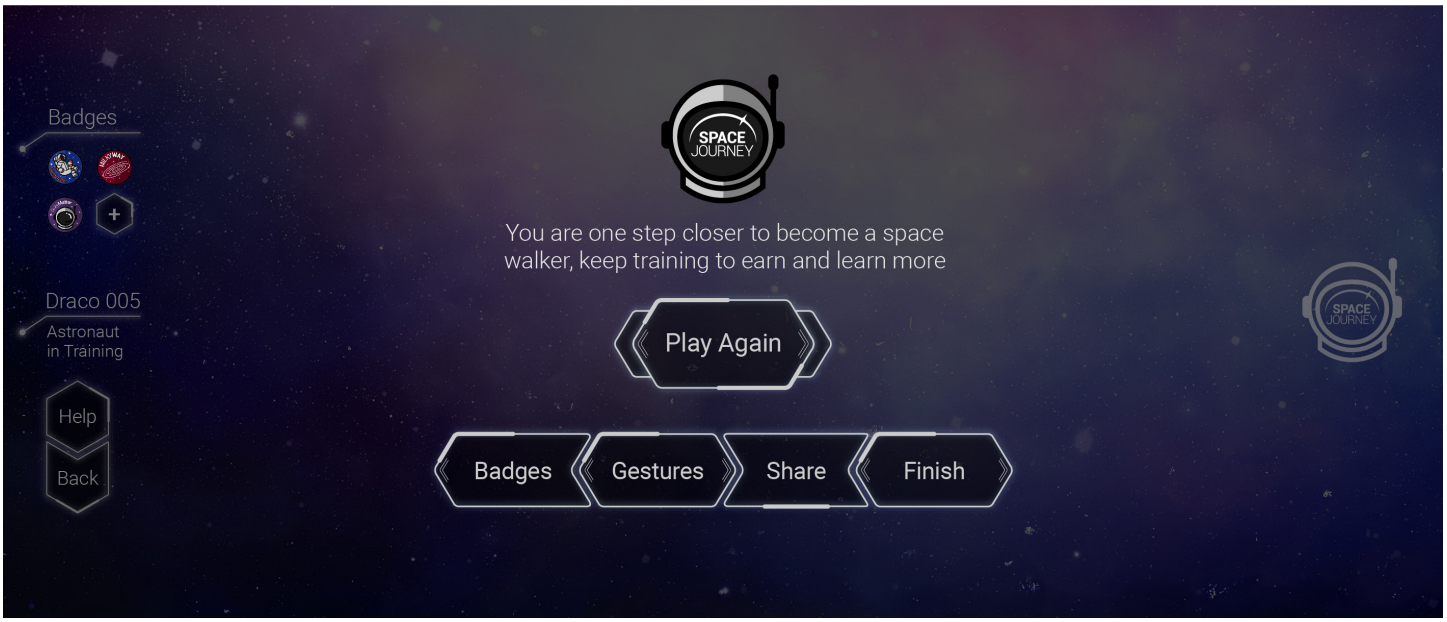


Figure 40. Challenges Completed 2 screen

Badge Collection

The badges earned by the user is shown along with the entire collection of badges on this screen for the user to appreciate and if desired, play more to earn more badges.

Figure 41. Badge Collection screen

Gesture Guide

List of gestures necessary to control the installation.

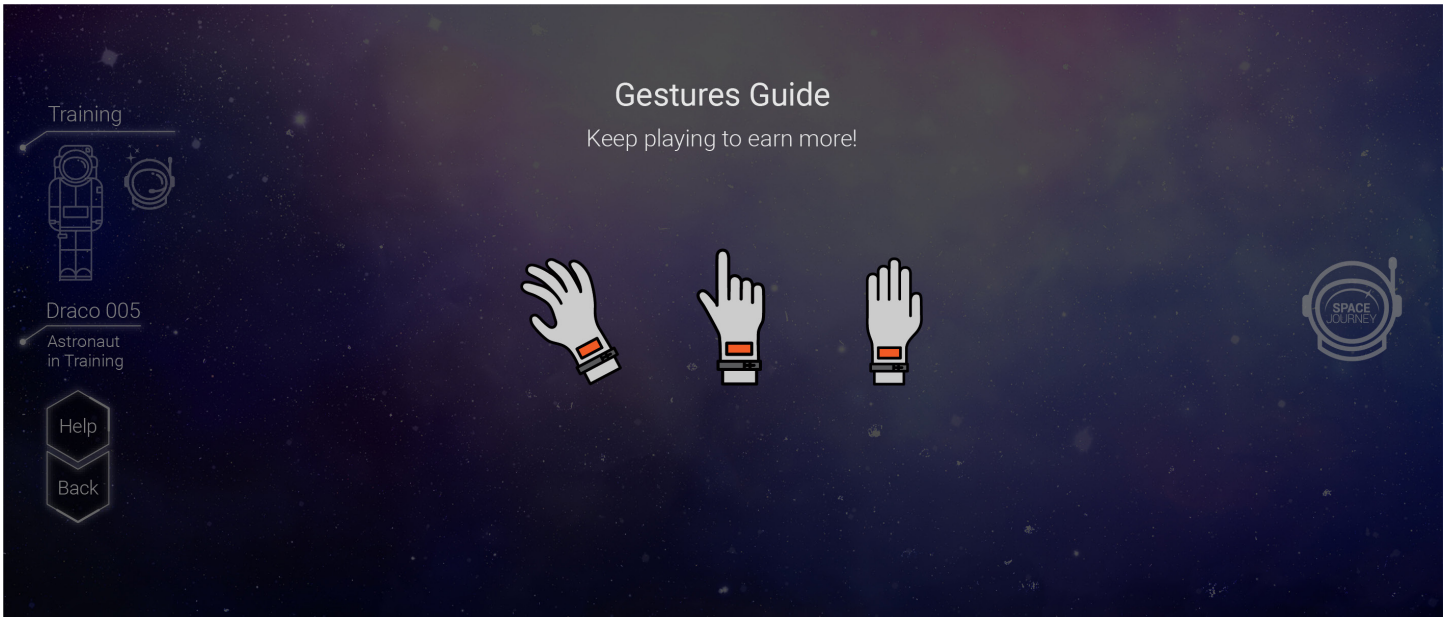


Figure 42. Gesture guide screen

Share window

To allow the user the possibility to share online the results and achievements, a pop-up window is shown when they hit the Share button, and they can use their personal phone to share online through their social channels or email.

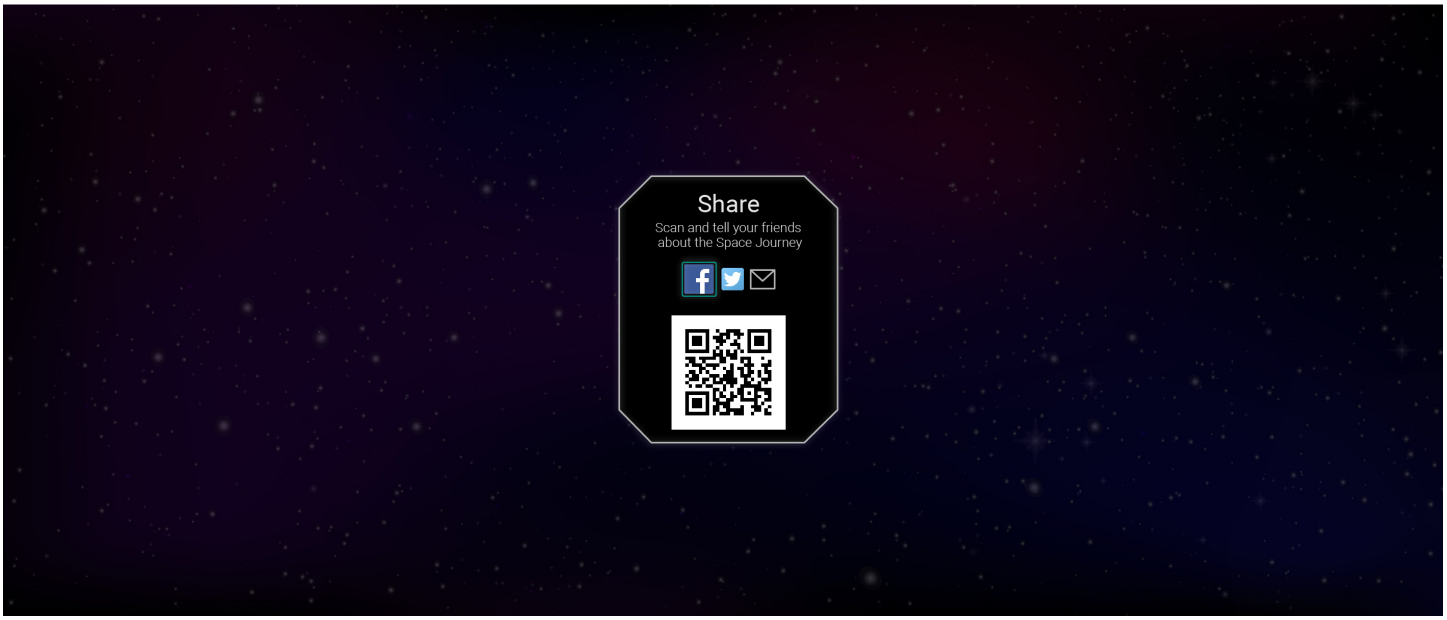


Figure 43. Gesture guide screen

USER TESTING

The final wireframes were developed after reviewing the results of the lo-fi wireframe testing, the user testing was conducted and the feedback was received through a combination of various discussions with additional designers and general users. Additionally, some comments and feedbacks were received during ImagineRIT 2017 exhibition.

Feedback & Considerations

- In each challenge, show user errors visually.
- Show elements to encourage the user
- Consider VR application for future considerations.
- 3D elements for future considerations.
- Visual color code between icons and buttons.
- improve sound effects.
- Good display of fact, more fun facts.
- Good badge design, possible save and buy system for users.
- Online ranking system

User testing survey

The analysis below was generated based on the feedback obtained through surveys and ImagineRIT comments.

Figure 44. Result of survey and user testing

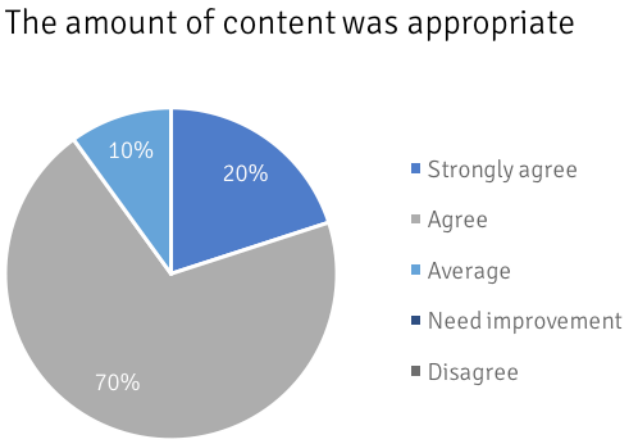


Figure 45. Result of survey and user testing

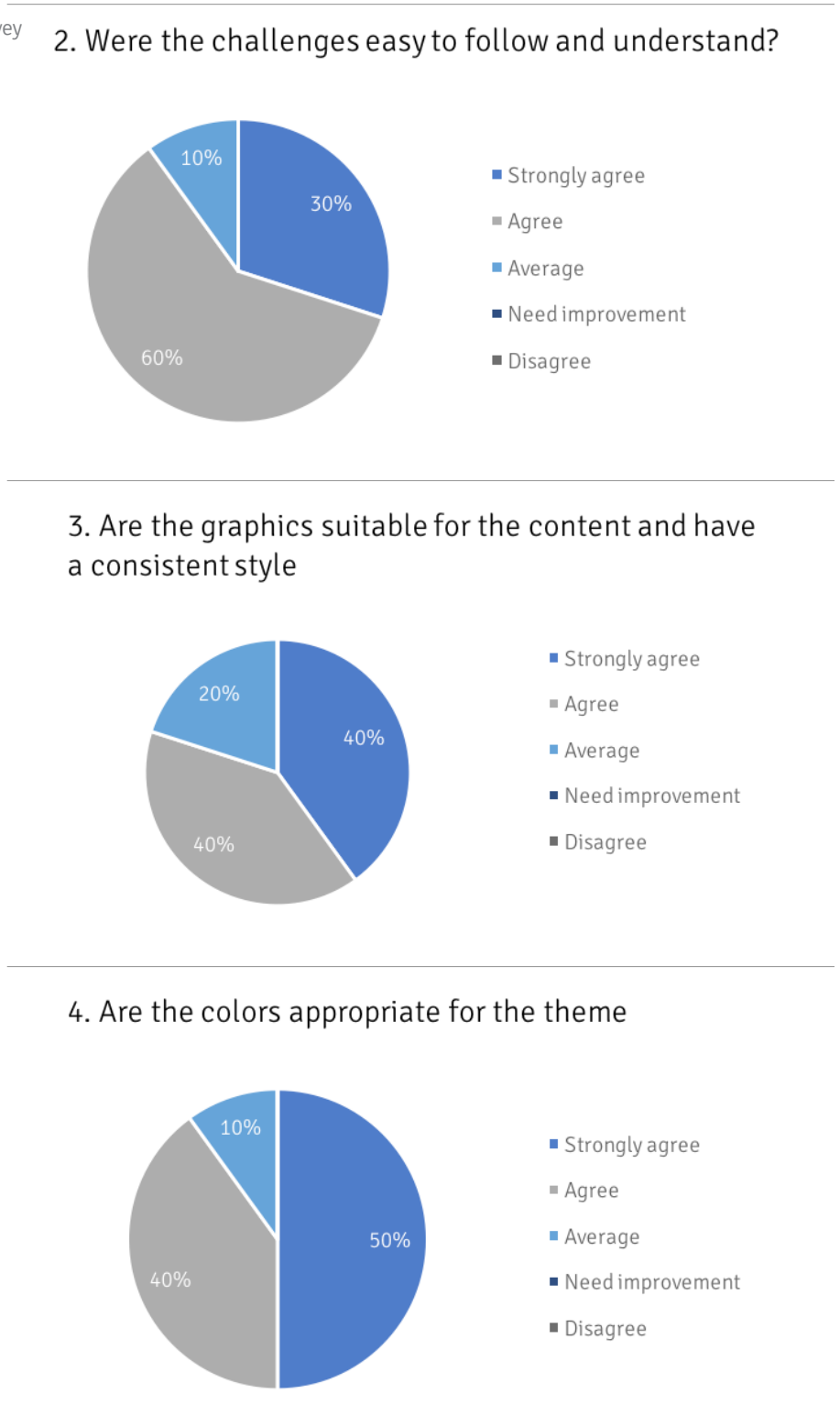
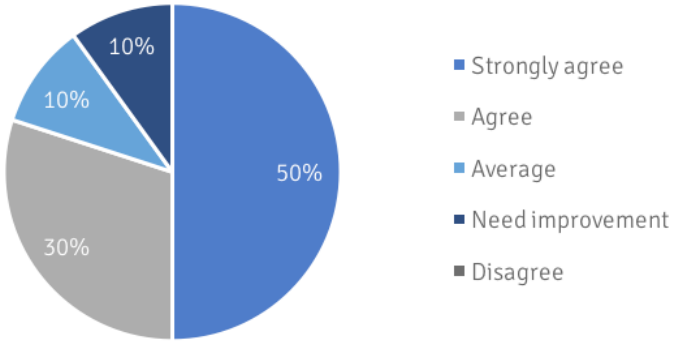
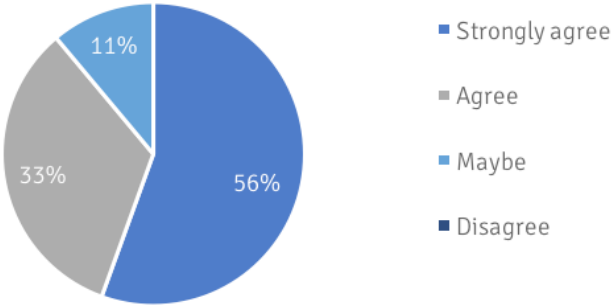


Figure 46. Result of survey and user testing

5. Was the format suitable for learning?



6. Could this installation be implemented in museums or educational centers



7. Overall visual Style

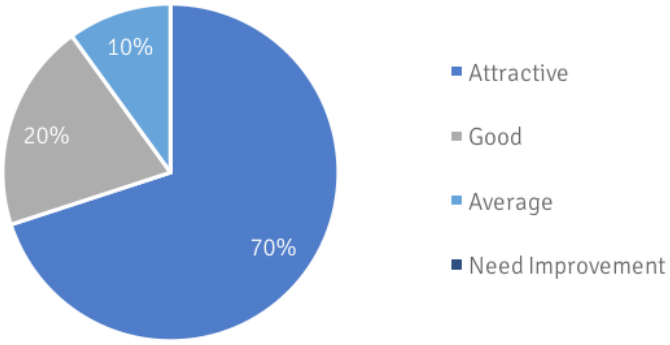
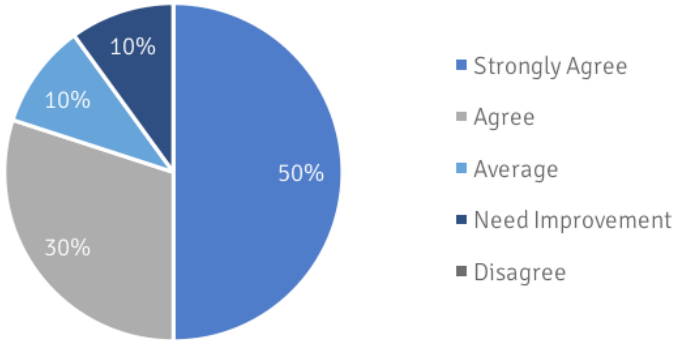
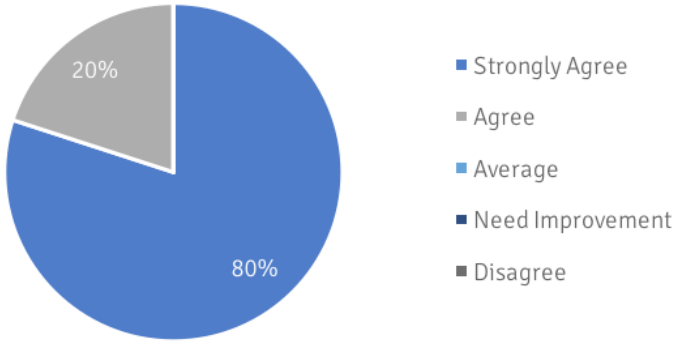


Figure 47. Result of survey and user testing

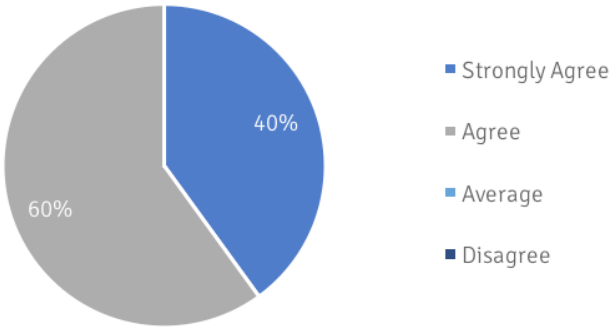
8. Navigation easy to understand



9. Was the type legible?



10. Would you be motivated to use this installation again?



11. What did you enjoy or would improve about the experience?

I liked the constellation game
The colors and overall style
I like the colors and icons
It was cool, I would’ve like more audio
Some of the info windows are too fast
I really liked it
Interesting idea, I would like to actually play the games
It would be good for VR
More mind challenges
Good experience with the games
I would love to see it in a science museum

CONCLUSION

This thesis proposed a method to incentive the younger generations to follow careers in science education, specifically astronomy and to explore a possible career as an astronaut, as well as a method of entertainment and learning for general users, who are interested in space-related subjects. This project could potentially be used in museums and education centers, as well as for personal use.

While there are multiple apps and mobile games that educate and entertain users about space, there are few or none that propose an immersive experience where the user, using gestures, can control and experience it at firsthand, in this sense Space Journey represents a good opportunity, using different technologies to approach the users to astronomy and astronaut education.

The proposed solution integrated multiple technologies including Projection design, gesture recognition systems with UX design which helped craft an experience that is meaningful to the user learning process and entertainment, using as well, Game Design elements to make the experience more engaging and dynamic.

As the research for this project shown (Appendix 1, Data analysis), within a certain number of users surveyed, 88% of the people would like to know more about space and in museums environments, they prefer interactive, virtual and augmented reality exhibitions, demonstrating that the proposed solution for this project would be a potentially successful asset for a museum or educational center to learn more about space.

The evaluations done with the users consisted of surveys and personal user testing, and it proved that people are interested in learning about astronauts and in utilizing different methods of learning and entertaining. Responses to Space Journey where positive, many good reviews and recommendations were given to further considerations.

Besides the functionality of the UX, the aesthetics were as important when discussing user usage, and to create an immersive environment. Visual aesthetics helped to guided and

inform the user throughout the interface of the installation, and the visual feedback helped the users to determine the functionality of the interface, the information given as a part of the process, and to minimize user errors.

In conclusion, this thesis was intended to serve as a tool to facilitate learning and entertainment to not only younger generations but adults and space enthusiast. Demonstrating that using different technologies can be beneficial to improve the learning process.

APPENDIX

61 Data Analysis

70 Thesis Proposal

DATA ANALYSIS

As part of the research, a survey was conducted with the purpose of collecting information of general people's opinions regarding space and astronauts, to generate ideas and possible ways to focus the installation.

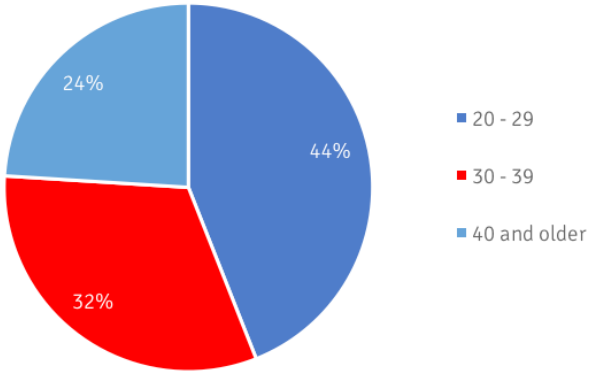
Space Journey Survey

25 responses

Publish analytics

How old are you?

25 responses



What was your childhood career aspiration?

24 responses

doctor
Geologist
economist
economist
Truck/garbage man
Pilot
Teacher
Cientist
Painter
Indiana Jones
race car driver
Scientist

Doctor or mad scientist
Animator
Cartoonist
professional baseball player
Doctor
Horticulture ,own greenhouse
Artist
Cartoonist for Disney
teacher
To work for the UN as an interpreter
Veterinarian
astronomer

Do you dream or ever dreamed of becoming an astronaut? If yes, when and why?

25 responses

No (12)
no (2)
No
Only as an adult, but realized I lack knowledge is science and math to become and astronaut
Yes! I was curious about exploring beyond planet earth.
No, seemed risky to me
Yes. I was 8 years old
Yes when I got really into Science. Around the age of 21. Who doesnt want to work fot Nasa?
Yes younger age
Nope
It was not a dream. But I always thought it could be awesome to be an astronaut. Specially when the videogame The Sims came out. I remember while playing, I was always joining the army as a career in order to become an astronaut.
Yes, space is interesting
yes, when I was in high school. Actually, my freshman roommate became an astronaut.

Do you like science? What aspects of science do you enjoy?

25 responses

No at all (2)
Biology
Love it! Discover new things!
I do, I love hearing about new species and new space discoveries, how Things have evolved and how they started.
I love science, physics is my most favorite part of it as it can answers every damn thing!
I enjoy science, primarily physics. I enjoyed how its applications were relevant in everyday life.
Universe and logics
Yes, observation
Yes! That it explains the magical things.
Yes. Science is the new reality that we live in every second. Reality changes constantly and science is a measurement of that.
Yes, the certainty of scientific data
That it's mind blowing. Not only does it help understand the world, it is also continuously making it better, smarter and more efficient.
Yes, solving problems
Yes
Yes. I rely on the concept of skepticism and hypothesis. The scientific method is the best we've come up with to determine truth from mythology
Yes! I enjoy Physics.
Yes, environmental science
No
Yes geology
I like science a medium amount but I'm not great at it.
Yes, zoology/biology/earth science
Yes biological sciences
Yes. I have degrees in physic, mechanical and electrical engineering.
Yes. Astronomy, environmental, computing, math

Are you familiar with the astronaut training process? If yes, please explain.

25 responses

No (7)
Just what the movies show (2)
no
Sort of
Not really, just things seen in movies, under water raining, g-force training
No, I have no clue about it
No, not very familiar. Only that they have to be certain heights, be physically fit, and can operate the aerospace system.
Not so much
Yes. Water diving, low gravity training, fllight simulation, test flights....
A little bit, zero gravity is the first thing that comes to mind.
A little bit.
Not really
Somewhat. I know about physical tests as well as long term isolation testing. I know about training in weightless environments like swimming pools.
A little bit. I know it's a rigorous training. Physically and Mentally.
I know that they do underwater training and use a centrifuge.
Not really but I know it’s physically and emotionally rigorous I love
Not much. Just know from what I have seen in movies.
A little. I've seen many TV shows about the process.

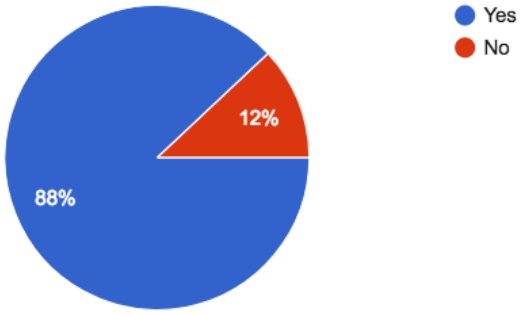
What do you enjoy about space and/or astronauts?

25 responses

That amazing and infinite landscapes (2)
Stars (2)
The fact they get to discover knew things out of space
New discoveries
The infinite of space, so many possibilities and unknowns about space. Thinking about aliens and other organisms
Witnessing and observing behaviors of unusual object of universe
The mystery of all that is out there, and how the times we are currently living in are making great strides to discover it.
All the possibilities and the things we have to learn
Watching them float around in space
They are mysterious and unbelievably amazing
The endless possibilities of space. Astronauts are probably the most heroic or commercialized "scientist". They are heroes and they create a doorway to knowledge through science.
The thought of floating through the air and feeling weightless.
Love space movies!
Mysterious, learning so much more beyond what we see on earth
Space
The possibilities, the sense of gaining knowledge, and the idea of exploring the unknown
I found it interesting because it's something unknown. The inmensity of the space. I enjoy being out of my confort zone. The space is the farthest from any confort zone.
The dedication of astronauts and the unknown of space
Nothing
the thrill/fear of the unknown
I love Scott Kelly's description of the international space station. Especially the day to day life on long stays in space
I like the pics and data about our Galaxy and others, but I really don't think it is cost justified endeavor to support space stations with astronauts or send them to the moon or Mars.
visualizing what it's like on other planets, thinking about cosmology

Would you like to know more about space and astronauts?

25 responses



What devices do you use most for learning? For example: computer, phone, TV, book, tablet etc.

25 responses

Computer (2)
Personal computer (2)
phone, tablet
YouTube, phone, computer
Computer and phone
Laptop
Computer
Computer, phone, books
Computer and book
Computer. Social media. Phone
PC, phone, books.
Computer, books
Computer, phone, ipad, tv
PC and phone
Computer, books
Cellphone
Tv
Phone
Computer, phone, tv tablet.
computer, TV
Computer, books, tv
Book, internet via phone or computer
TV, book, computer

When you go to museums what type of experience do you like the most? For example: experiments, building, virtual reality, videos, reading, star shows, interactive shows etc.

25 responses

Experiments (2)
Building, kind of play (2)
interactive shows
Bulding, virtual reality, interactive experiences
Virtual and Augmented Reality experiences are the ones I enjoy the most
Visual exhibits and displays
Interactives and experiments
Interactive shows
Star shows, interactive
Seeing things Ive never seen. Hands on experiments are always more fun.
Hands on interactive experiences.
Depends on the content, mostly photographs, paintings, installations. Also enjoy specific design museums.
Experiments, interactive shows/displays
Interactive
Experiments & VR
Interactive shows and videos.
Star shows
Star shows, interactive exhibits
Clean, spacious galleries with items displayed well so that I can see them from multiple angles.
interactive exhibits
Mostly exhibits: art, sculptures
Anything interactive and informative movies
viewing and reading about artifacts, star shows

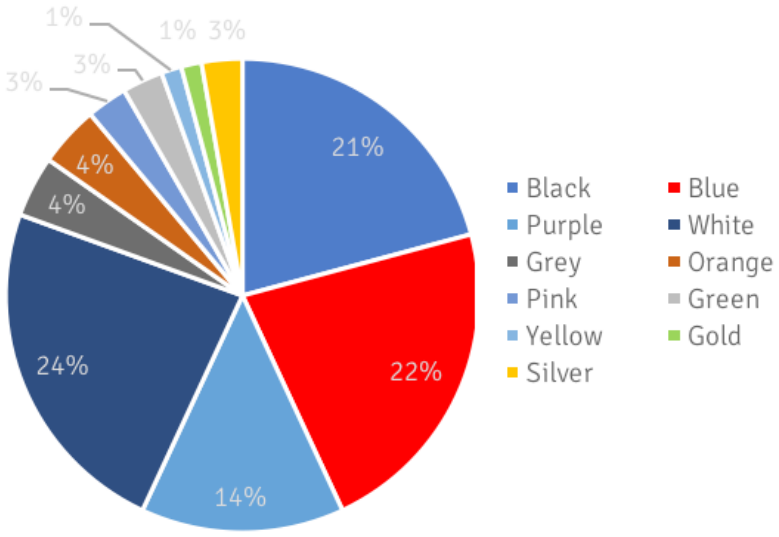
Of the experiences you mentioned above, what do you like most about them?

24 responses

Spend time without know how long time have you been there (2)
I feel like I learn more while doing something not just watching
Geology
I like using my hands to experience things, building and doing actions for learning rather than just watching something
Immersive nature of it. It engulfs one into its realities and has ability to mind map things occurring as if it is real
They allow for visualization of how the display would appear in the real setting. Sometimes the displays are the actual airplane or rocket, for example that might have been in flight.
Interactives. Because you participate in the process and explore the possibilities
Learning
Interactive
They usually give you a physical representation of conceptual ideas and scenarios, making science tangible and understandable. They bridge the gap and make science more than a metaphor but a working schematic or a "behind the scene" look at the miracle that is our existance.
Feeling like I am a part of the learning experience.
Content, context in time, size, visual design.
Interaction
I like the experiments that help clarify a concept for me
Interactive shows because they make every content easier to understand for me. Learning by doing. And videos, if they are well made, they can create a nice inmersive experience. And probably also because I work making videos.
Unpredictability
How many stars there
I am involved in the learning process. Figuring thing out for myself
I like looking at an artifact and reading some facts about it.
engaging more senses
Being in the presence of great works
Learning something new.
They make me think and put me in a different place

What colors do you associate with Space and astronauts?

25 responses



What elements do you like from space? For example: Meteorites, Rockets, Planets, Constellations etc.

25 responses

Planets and Constellations
Meteorites,constellations
contellations
contellations
Planets, rockets, aliens, infinity, black holes, the unknown,
Rockets and Constellations
Constellarions, planets, moons
Pulsars, supernovas, planets
Planets
Meteorites, Milky Way
Everything is technically "in" outerspace. Humans are the best.
meteorites, space ships
Constellations, other planets, the moon
Stars/constellations
Planets
Stars & constellations, black holes, planets, asteroids
Space Stations
Planets, stars, comets, meteorites
Constellations
constellations, meteorite, comets, planets
I'm not a huge fan of space. It makes me feel small and cold.
constellations
Comets, specific stars
Info on how the universe stated. Stars planets
all of the above + nebulae, galaxies, black holes, telescopes, very distant worlds

THESIS PROPOSAL

THESIS PROPOSAL

SPACE JOURNEY

Encouraging astronomy education and space exploration through an interactive experiential design installation of a virtual planetarium using a gesture based interface to explore the journey between the planets of the solar system

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November, 2016

MFA Visual Communication Design
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Thesis Committee Approval

Title
Space Journey: Encouraging Astronomy Education and Space Exploration through an Interactive Experiential Design Installation of a Virtual Planetarium

Author
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Submission Date
December 1, 2016

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Signature of Associate Thesis Adviser Date

ABSTRACT

Space journey is an interactive experiential design installation that explores the boundaries of the interactive user experience along with projection design to learn and discover the journey between the planets of the solar system, the starry sky and the countless astronomical objects in the universe using a virtual Planetarium that can be controlled by a gesture based interface.

Planetariums are the world's astronomy classrooms that creates educational and entertaining experiences and both inspire and educate not only scientists but general public of all ages about the surroundings of the Earth and the wonders of the Universe. Planetariums are a major tool in increasing science knowledge and have a valuable proposition to encourage astronomy education and space exploration.

In order to create a better user experience, it is necessary to bring new technologies into projection design to create the most efficient simulation of the celestial bodies. The idea of allowing the user to interact with the projection using a gesture base interface and make it an interactive experiential design installation comes from the need to increase knowledge and to produce an experience that the user can control. As a result, it would be a personalize modern experience for each user.

KEYWORDS

Space exploration, technology, projection, interaction, projection design, exhibition, user experience, experiential design, gestures, communication, gesture based interface.

RESEARCH QUESTION

How to encourage astronomy education and space exploration through an interactive experiential design installation of a virtual planetarium controlled by a gesture based interface to explore the journey between the planets of the solar system?

PROBLEM STATEMENT

Astronomy has always had a significant impact on the world view, and it is a good way of learning the basic principles of scientific knowledge. While there are a lot of advance in technology, there are still many unanswered questions in the field of astronomy. Planetariums are considered the best place to learn about astronomy but a lot of them are outdated, located in specific places and there usually fees involved that stop the audience from visiting.

The younger generation are used to newer technologies that are closer to the user and most of the planetariums use old projectors and technologies that does not attract new audience, especially the youngster that could possibly pursue a career in science and astronomy.

Encouraging astronomy education in younger generations is very important because astronomy contributes to the evolution of science and technology in a sense that it is always requiring new instruments and innovation to travel and research further in the universe, that means that it is always pushing science to constantly develop new technologies. Encouraging younger generation to study and research astronomy or science in general will have an impact in the society in terms of evolution of new technologies and knowledge of the universe.

In order to improve and encourage astronomy education, the goal of this thesis is to create and interactive experiential design Installation of a Virtual Planetarium using a gesture based interface, that will inspire the users through a journey in the space by creating a better user experience that provides them with a better understanding of the elements in space. In addition, the installation propose the use of a gesture based interface allowing the user to interact with the installation with their own hands.

Gestures are part of the human's native interaction language and nonverbal communication, ever since the touch technology was invented, the user had the capability of being closer to their actions by touching and making commands directly to their devices, but what if these devices are not a barrier and this commands comes directly from the hands? Touchless gesture technology is relatively new, many of them uses cameras or sensors that reads the users movement but it has not seen successful widespread use.

The idea is to use a device or sensor that registers the dynamic hand motion in order to manage the projection on the installation allowing the user to control it by using their natural language which is much more intuitive and effortless when compare to touching a screen, mouse or remote control. Gestures can create a comfortable user experience that strives to understand the human language, in that way, powering the next wave of electronic innovation.

SITUATION ANALYSIS

Astronomical research and discoveries attract the human imagination by creating a connection between the origins of humans and the nature of the universe. Astronomy as the scientific field that explores the wonders of the universe and its countless celestial objects, it has been used to solve questions related to the evolution but also it has been the propeller of the development of technologies that nowadays is not only used in space but in everyday appliances.

Astronomy education has the potential to add significantly to science education and improve public science literacy, Astronomy research has revolutionized the world thinking by increasing the knowledge of the earth and its surroundings and it has acts as a window into the immense size and complexity of space. Encouraging astronomy education in younger generation could impact positively in the world by inspiring new scientist and amateurs to keep exploring and researching the universe and through them, science and technology could inevitably evolve.

One of the most inspiring ways that has been used to attract people to astronomy education has been for many years, the planetariums. These places acts as classrooms for astronomy education and entertainment not only to scientist but to general public. Though planetariums, the public has had the opportunity to have a closer look to space, constellations, starts and planets. planetariums allow astronomical concepts to be demonstrated in a three dimensional environment that significantly helps spatial understanding of the universe. The planetarium setting is not only educationally effective but also awe-inspiring, increasing public enjoyment and interest in science.

On the other hand, human interactivity has evolved through the years, specifically interaction with devices that has been developed with the technological advances. Users and especially young generations has grown in a world with many digital devices that connects them with limitless knowledge, people and places without the need of moving from their location. There are new technologies every day and multiple ways to create interactions between users. This thesis seeks the connections of young generations to science and astronomy education throughout the use of new technologies that creates experiences that connects the user with the universe, and brings them more knowledge and enjoyment.

THESIS STATEMENT

A proposal to encourage astronomy education and space exploration through an interactive experiential design Installation of a Virtual Planetarium using a gesture based interface to explore the journey between the planets of the solar system.

SURVEY OF LITERATURE

The primary areas of research for this thesis are astronomy education, planetariums, user experience, interactivity and experiential design.

Exploring the research about astronomy helps broaden the horizons of the knowledge of astronomy education, and helps finding the solution for encourage the astronomy education in young generations.

In addition, is it important to navigate between the research that has been made on user experience, interactive and experiential design in order to find a solution that adds to the field of design and also that solves the problem in an efficient way.

IMPORTANCE OF ASTRONOMY EDUCATION AND PLANETARIUMS

Staffan Klashed

Planetarium Design & Planetarium Software. August 11, 2015 http://sciss.se/news/id/34

White Paper: The next 20 Years - A Vision for Planetariums in the 21st Century

This paper demonstrates the importance of the planetariums for astronomy education and entertaining and suggests that the planetariums changes the perception of the public making them as a primary place to follow events in astronomy and space exploration. It also demonstrates through the paper the great interest in the audience towards planetariums and that it is necessary to maintain new technologies to properly educate and entertain, this is very relevant to this project because it could help find a solution to the problem presented in order to increase the interest in astronomy.

James G. Manning

Astronomy Education
June 1994
https://goo.gl/DMO1Tw

The Role of Planetariums in Astronomy Education
This journal describes the planetariums as environments that encompass the audience, and its role in the astronomy education in relation with the audience, expressing that it brings the planetariums and the public together into the experience in a way that classroom, book, television or computers screens cannot. That it combines and effectively use audiovisual technology to help create better experiences.

Marissa Rosenberg, Pedro Russo, Georgia Bladon, Lars Lindberg Christensen

International Astronomical Union
https://goo.gl/RFX9M1

Astronomy in Everyday Life
This article the authors outline the reasons why astronomy is an important part of society, focusing mainly on the technology and the technology transfer. They describe the relation of astronomy with industries, energy, medicine and everyday life, showing the impact that astronomy has in the world, and its benefits through the investment is science and astronomy education.

Evry L. Schatzman

August 1972
https://goo.gl/RrsvS4

The Importance of Astronomy in Modern Education
A Journal that express the importance of the scientific education emphasizing in astronomy and demonstrating why this scientific field. Also explains through part of history the influence of science in the major events on the past and the civilization.

Astronomy and Astrophysics in the New Millennium.

2001
https://goo.gl/Y9dOfi

The Role of Astronomy in Education.
In this book, the authors describe the role of the science education and astronomy and encourage the understanding in this matter, in order to creates success in educational projects in astronomy. Also it explains about how the astronomical community augments significantly to the continuing effort to strengthen science education and adds that the interdisciplinary nature of astronomy and its natural links with technology and instrumentation position the field to contribute significantly to building a strong technical work force for the 21st century.

GESTURE BASED INTERFACE AND INTERACTIVITY WITH THE USERS

Brian Dipert, Yair Siegel, Simon Morris, Liat Rostock, Gershom Kutliroff

EE Times
April 2013
https://goo.gl/pMG1ls

The gesture interface: A compelling competitive advantage In the technology race

This online article declares the advantage of the gesture base interface and how it can be used for different purposes, it also states the different kinds of gestures recognition systems and its potential use in different fields, showing their advantages to technology, and its versatility to use in many situations as a natural type of communication.

Julie Rico, Andrew Crossan, and Stephen Brewster

Book
Human-Computer Interaction Series
2011

Gesture-Based Interfaces: Practical Applications of Gestures in Real World Mobile Settings

This chapter describes the aspects of gestures design for mobile gesture and body-based interaction, including the different methods that can be uses in different situations. It narrates a little bit of history of the gesture interface and its implications related with social acceptability, its performance, the technology and the different body gestures that can be used for creating successful gestures interfaces.

Moniruzzaman Bhuiyan and Rich Picking

Centre for Applied Internet Research (CAIR)

Gesture-controlled user interfaces, what have we done and what's next?

This paper gives an overview of gesture-controlled interfaces in the last 30 years. Investigating different types of gestures, its users, applications, technology, issues addressed, results and interfaces from existing research. This paper also provides research for gesture controlled devices for elderly or disabled people concluding that they need more technology using their natural behavior as a result the gesture base interface could be a good way to support them.

Jeff Hecht

Laser Focus World.
January 25, 2011.
https://goo.gl/bjK59R

PHOTONIC FRONTIERS: GESTURE RECOGNITION: Lasers bring gesture recognition to the home

This article explores the Gesture-recognition technology using laser based techniques, describing the basics and background, explaining how the infrared system works but also comparing different recognition systems that exist in the market describing their main use, and the potential market for this gesture recognition systems.

Gail Overton

Laser Focus World.
April 29, 2013.
https://goo.gl/LR6rLD

Gestures, cameras, and projectors combine for smart touchscreen environments
This online article asserts in the possibility of combining projectors with gesture-recognition system in order to turn any surface into a touchscreen. He listed some researches that has been made about gesture recognition process, describing how these researchers has developed the recognition systems and suggesting that according to then, in the future there might be a possibility of interaction with systems in free spaces.

Attila Licsár and Tamás Szirányi

Book
In Computer Vision in Human-Computer Interaction
Prague 2004.

Hand Gesture Recognition in Camera-Projector System
A paper that describe the realization of a vision-based hand gesture recognition system, in order to create an augmented reality tool using camera-projector systems, it explains the functionality of the tool and the elements that influenced on the project, as a result this vision-based gesture recognition system and the camera-projector configuration proposed a natural way to control multimedia presentations or manipulate directly the projected image, a method that has been tested with significantly efficiency.

VIDEO REFERENCES

Bogdan Oliynik
Vimeo. 2013
https://vimeo.com/84043137

F 63.9 Maladie d'amour, Holographic Planetarium, Making of
this video is a holographic planetarium idea, that includes the process of making the graphics to the result of the piece.

Sodazot
Vimeo. 2015
https://vimeo.com/120944206

Quantum Space / interactive room
Interactive video room/installation, based on a digital meditation. For Life Zone exhibition at M'ARS Gallery, Moscow.

Rudransh Mathur and Ankkit Modi
Vimeo. 2012
https://vimeo.com/120944206

Conductive Orchestra (Interactive Installation)
Conductive Orchestra is an interactive installation that lets a user conduct / compose an electronic orchestra.

COMPARATIVE ANALYSIS

There are multiple apps with similar purpose of space navigation, most of them are very technical in terms of content with excessive amount of information, for instance NASA have several apps in the market most of them have extensive amount of technical information that in some cases are difficult to understand and overwhelming.

Similar apps are available as well that are hard to understand and learn from them. Some of them have maps of space and indicate names of objects and constellation but with the only purpose to inform, as a result these apps might not keep the users attention for long due to its lack of extra purpose, for instance if the app just shows names and general objects on space, eventually the user might get bored of just looking at names and not interacting with it.

The following are similar mobile apps and websites with similar purpose of this project:

NASA: General information of space, missions, social media, news, images and videos.

NASA Viz: Information about specific objects or events on space.

SkyView: Exploration of space using augmented reality and location.

TerraGenesis: Game with different challenge on space, very technical.

StarTracker lite: Exploration of space using augmented reality.

Night Sky: Exploration of space using augmented reality.

DESIGN IDEATION

The process of ideation comes from the synthesis of the research and information collected throughout the development of the proposal for the thesis, and the use of different techniques in design to generate solutions.

Information architecture

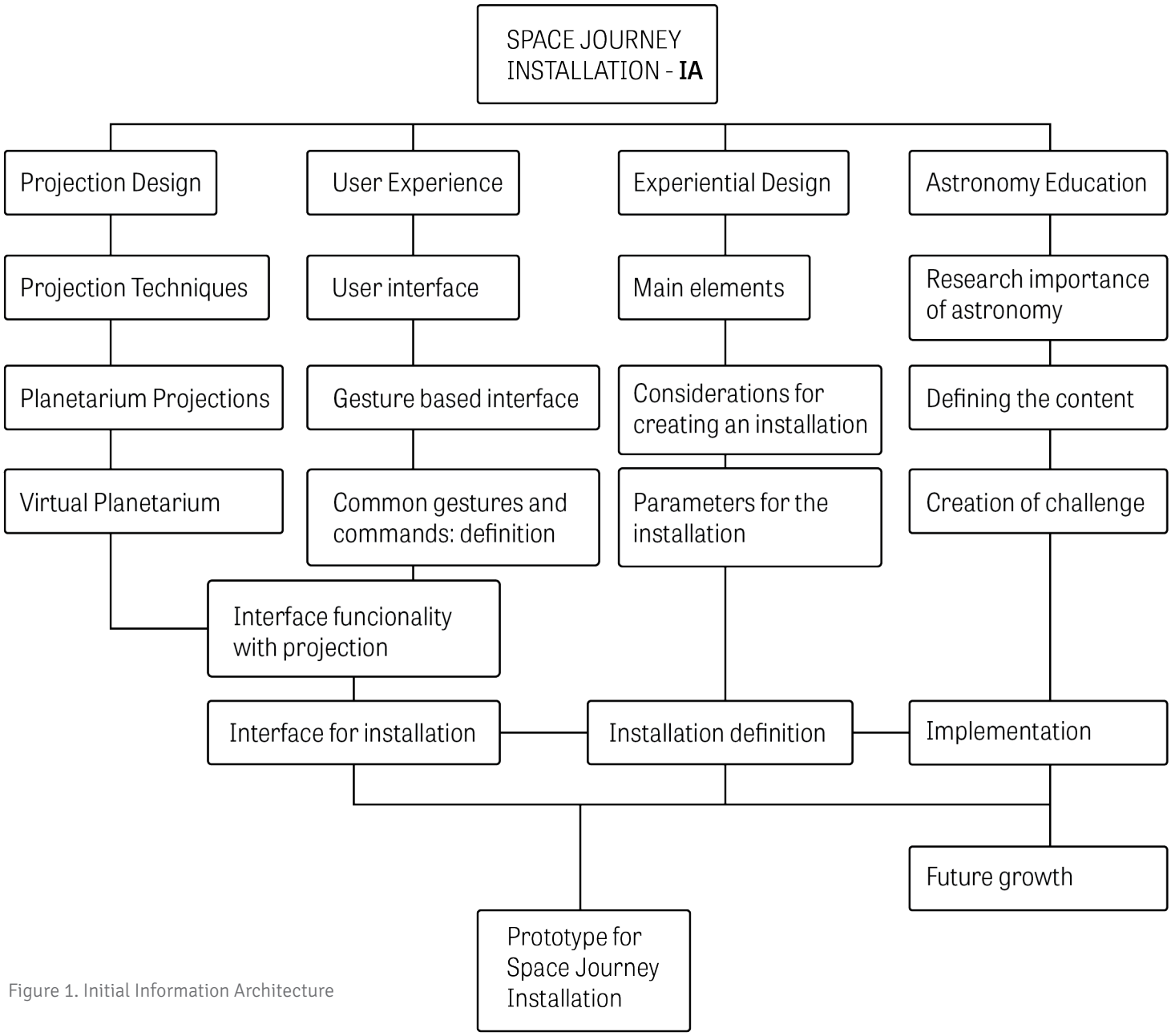


Figure 1. Initial Information Architecture

Possible visual design components

Geometric shapes that illustrates elements of the space

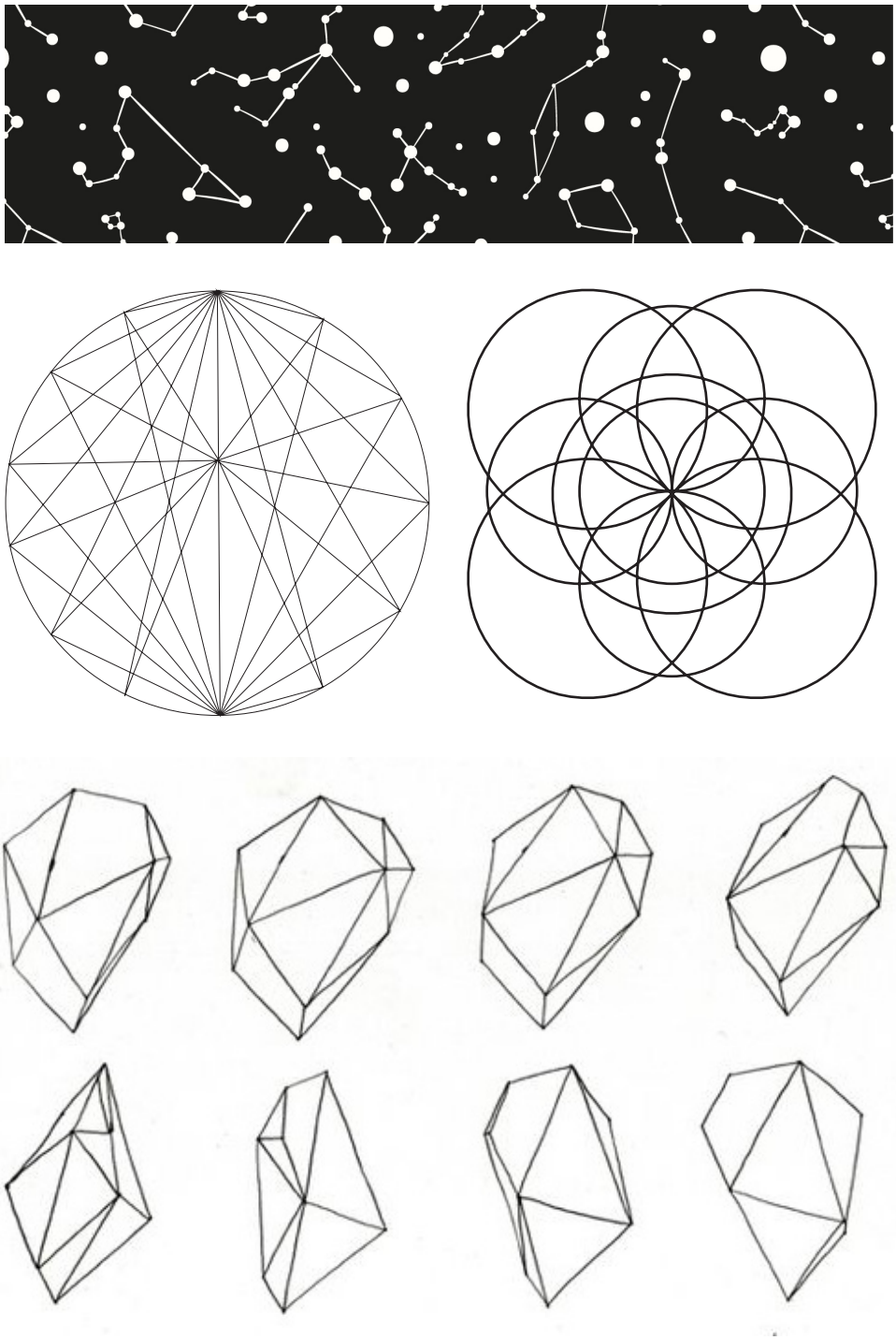


Figure 2. Drawings and first sketches of visual design

Color scheme

The color scheme will be inspired by the colors in the photography of the stars, nebulae and galaxies that has been provided by the international space station and the different space organizations.

Figure 3. nebulae and space images.
Source: http://www.colourlovers.com/blog/2008/05/06/colors-from-outer-space

RGB 153, 9, 34 HEX 990922	RGB 118, 16, 37 HEX 761025	RGB 98, 74, 116 HEX 614974	RGB 35, 89, 99 HEX 235963	RGB 53, 176, 181 HEX 35B0B5	RGB 119, 213, 89 HEX 77d559

Space Journey Challenge: Explore The Journey Between the Planets of the Solar System

In order to stimulate the user to interact with the installation and keep them interested, a challenge will be created, the idea is a game base challenge where the user has a mission to accomplish and once they achieve it they get a reward.

Through this mission, it is expected that the user will learn about space and the planets in an interactive way. With better possibilities of knowledge retention and have a joyful experience and entertainment.

Mission: Explore The Journey Between the Planets of the Solar System

Time: between 1 to 5 minutes (to be determine)

Free exploration: once the challenge ends, the user has the possibility of free exploration on space.

Social media sharing: sharing capabilities for more dissemination

Space Journey Challenge_ Initial Flowchart

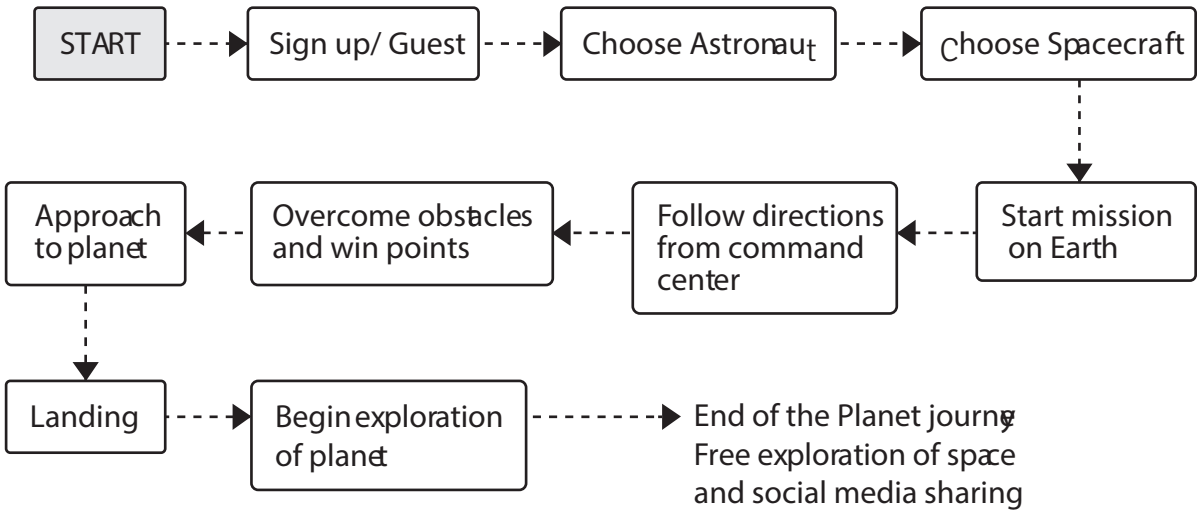


Figure 4. first user flowchart

Gameplay

Initial directions and rules that the challenge might follow, including the rewards system and the learning goals that the user will gain through the game.

Learning Goals:

Learn from interesting science facts.
Technology involved in astronomy and in everyday life.
Astronomy education, solar system, planets, stars, and general celestial objects.

Game Rules:

User is an astronaut.
Choose spacecraft in which he/she will have to maneuver using hand gestures.
The astronaut should follow instruction from the command center.
Overcome obstacles on the way, asteroids, satellites and objects.
Achieve purpose by landing successfully in the planet.

Rewards:

Knowledge of interesting facts of the space and technology.
Points-based rewards system.
Online ranking.
Social media recognition.

Gestures

Gesture based recognition system based on hand motion
Possible body motion recognition

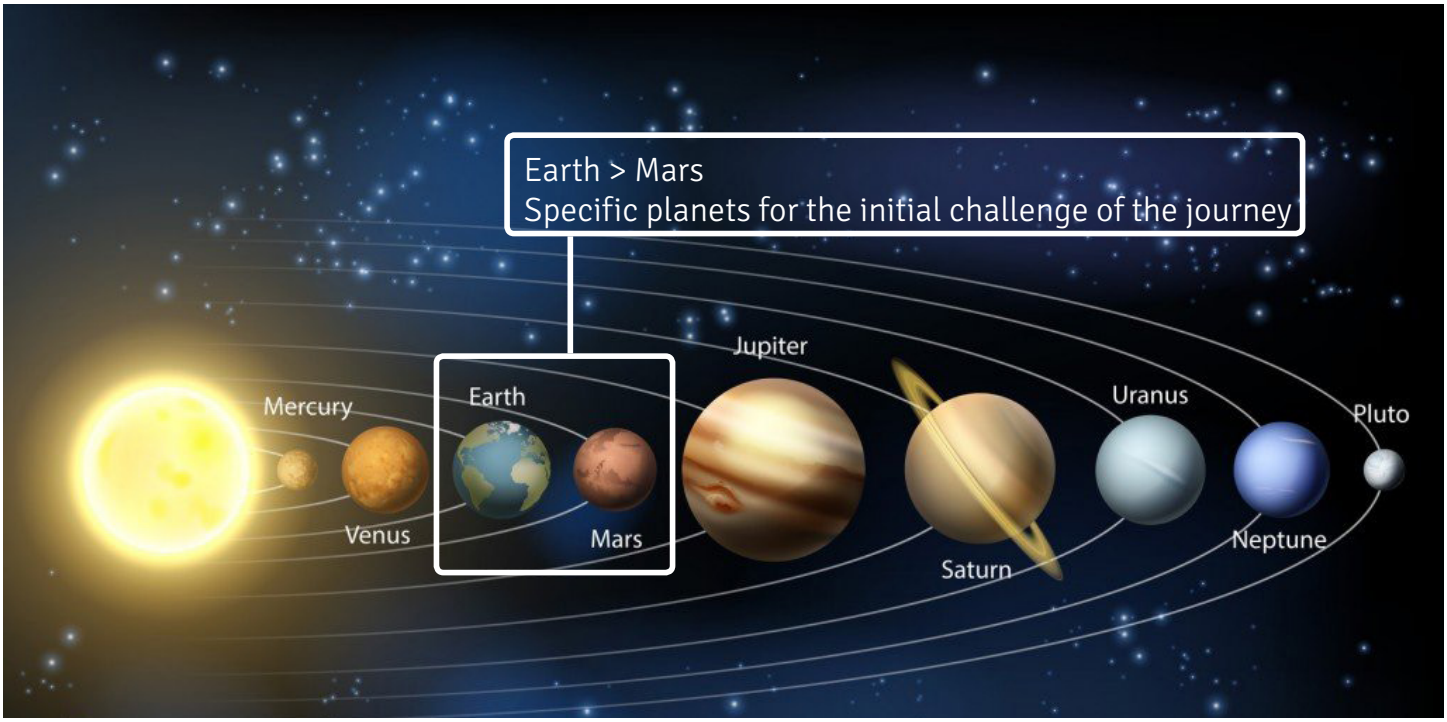


Figure 5. Planets Solar theme sketches in order Space 3D Graphics.
http://www.1zoom.net/Space/wallpaper/458801/z2042/

Location of the initial Challenge

Starting point is Earth and the journey will be to Mars.

The obstacles and objects presented during the journey attempt to represent real objects as much as possible.

As initial challenge it starts between these two planets only, but in the future, the installation could possibly grow into journeys between any other planet in the solar system.

METHODOLOGICAL DESIGN

Methodological Approach

In order to develop an effective solution to this project, the methodology that will be applied will be based on the combination of element of user experience and user interface with emphasis in the user behavior towards the interaction with devices and interactive projections, and experiential design which will explore design techniques and new technologies that involve projection design, installation design, environmental graphics, user interactivity with emphasis in gesture based interfaces.

With this in mind, the goal of this project is to develop an installation that involves experiential design and user interaction, using a gesture based interface that allows the user the complete control of the experience, shown through projection.

The content of the installation is basically space exploration that will be shown through a series of challenges or task, to guide the user through the installation and in that sense, the information will be communicated in a more organized way. as an initial proposal, this project will develop one challenge for the user to follow throughout the installation, but in the future the ideal for the installation will be to have multiple challenges with more information about the universe.

Target Audience

This project is mainly targeted to younger generations that are in the process of defining professional careers for their future, with the possibility of encouraging them to pursue astronomy or science and technology education. It could be for older children from 10 years old approximately and beyond, but it is not only limited only to children but also to adults and amateurs of the subject.

This project strives to communicate in an easy and understandable way the elements of the universe with the goal to inspire its user to continue exploring space in order to comprehend and learn from astronomy and its impact to society and encourage science literacy.

PERSONAS

Sally Kingsburg

Figure 6. User persona 1

Age: 12
Occupation: Student
Location: Rochester
Character: Quiet

"I like going to science museums to see different exhibits about science but my parents can't take me often to the museum"

Biography
Sally is a kid that loves to read, and do science experiments, she cares about doing well in school. She rater be indoors than outdoors. She is excited to take more science classes at school. She likes watching documentaries with her parents, Planet earth is her favorite show.

Goals
Do well in School
Win the science fair at school

Tech skills
Internet 82%
Mobile Apps 75%
Social Media 60%

Elijah Soto

Figure 7. User persona 2

Age: 11
Occupation: Student
Location: Baltimore
Character: Active

"I love sports and games that make me think, specially brain games"

Biography
Joshua loves playing sports and making videos for social media, love to play with his Rubiks cube and other type of mind challenging games. His dad is a teacher and mother is a stay at home mom. He does not know much about planets but would like to learn about it.

Goals
Become a professional Baseball player

Tech skills
Internet 70%
Mobile Apps 75%
Social Media 20%

PERSONAS

Paul Dakota

Age: 30
Occupation: Graphic Designer
Location: New York City
Character: Extrovert

Figure 8. User persona 3

"Being in the design world I like to keep up to date with technology, it helps me being more creative"

Biography
Paul plays the guitar after work, loves to travel and visiting new places. He's technology driven and loves having the newest tech toys in the market. He's very active and likes outdoor activities like biking, running and hiking. He likes museums but prefer the ones with more interactive exhibitions, his knowledge about science and space is basic but would like to learn more about it.

Goals
Travel around the world
He would like to incorporate his passion with design and technology

Tech skills
Internet 90%
Mobile Apps 95%
Social Media 80%

Anticipated Hardware/Software

Since this project involves multiple digital media platforms, the hardware and software that is propose to use will vary depending of its purpose. For the projection of the universe and planets in the space, it is intended to use a projector that could be easily portable to set the installation everywhere and that it will be connected to a sensor for its manageability.

This projector will be connected to sensors that allows the functionality and recognition of the gesture based interface. these sensors or devices could range from commercial products as Microsoft Kinect or infrared sensor for movement recognition, this will be determined through the research.

The content will be created as a mobile app that will contend the information of space, ideally it would show real footage from space that could be provide by any astronomy organization but in this proposal it is intended to create a simulation of the space with many similarities to the real space.

Composition

The installation pretends to immerse the user in the projection, encouraging them to interact and achieve the challenge presented, in order to implement the immersive experience, the installation should surround the user, possibly in a three dimensional space, simulating a planetarium, where the user could interact with the projection in any direction, but it could also be a flat surface.

The dimension of the composition will be determined through the development of this project but the goal is to create a single user experience. That being said, the format and dimensions will be the appropriate space for one or two users at a time.

Interactivity

The intention of the project is to explore new ways of interactivities between the user and the devices or spaces, the idea is to use a gesture base interface that will allow the user to navigate throughout the challenge presented, without the need of an extra device like a phone or tablet.

Through the exploration and development of the gesture based interface, it strives to create new possibilities of interaction that creates interactive experiences that connects the user more directly to the knowledge.

DELIVERABLES

The final result of this project intends to be a proposal of an installation that uses projection design to present the universe and the challenge that the users will follow.

This proposal will include examples on how the navigation will work in the installation, providing information about how the gesture base interface and how it will work with the installation. The content of the challenge for the user that will include the steps that the user will follow and the story behind the challenge.

As digital deliverables, it will include: High-fidelity app prototype that allows user interaction and testing, UX design document with competitive analysis, user personas, process, information architecture, flowcharts, sketches, wireframes with annotations, style guides, visual identity, logo, moodboards, final UI design.

The implementation of this thesis comprehends the use of adobe software to develop the user interface. The content for the installation will be determined by the research about astronomy and it will include the challenge for the user and the extra content that could be included within the installation.

The realization and implementation of a prototype that simulates the user interface of the installation in order to get user feedback and study the behavior of the user towards the gesture based interface and defining the best way to establish the gestures that will be used to control the installation.

DISSEMINATION

The plan for dissemination starts by presenting the proposal and prototype at RIT:

- VCDE Thesis show 2017
- Imagine RIT 2017

The following steps after presenting in RIT will include submissions to design competitions, submission to the Rochester Museum of Science as a possible exhibition in the planetarium and exposure through design networks and portfolio websites such as:

- Adobe Design Achievement Awards
- HOW Interactive Design Awards
- IxDA Student Design Challenge
- The Communication Arts Interactive Design Annual
- Computer Arts Graduate Showcase
- NASA space app challenge
- Behance Creative Network
- Adobe portfolio online

EVALUATION PLAN

The evaluation plan consists in the prototype user testing focused on evaluate the user behavior towards the gesture base interaction and the best way to improve the interactivity. The testing will be done, preferably but not limited, in children and adults.

The prototype testing will be done using an initial prototype in which is expected to get feedbacks and the second testing will be using a high fidelity prototype with all revised feedbacks of the initial prototype.

Both prototype testing will be qualitative due to it will be used to gain an understanding in the user behavior and will help develop ideas through individual testing, interviews, and observation.

PRAGMATIC CONSIDERATIONS

The initial cost for the development of the prototype will involve software and hardware:

Adobe creative cloud $30 monthly for Students

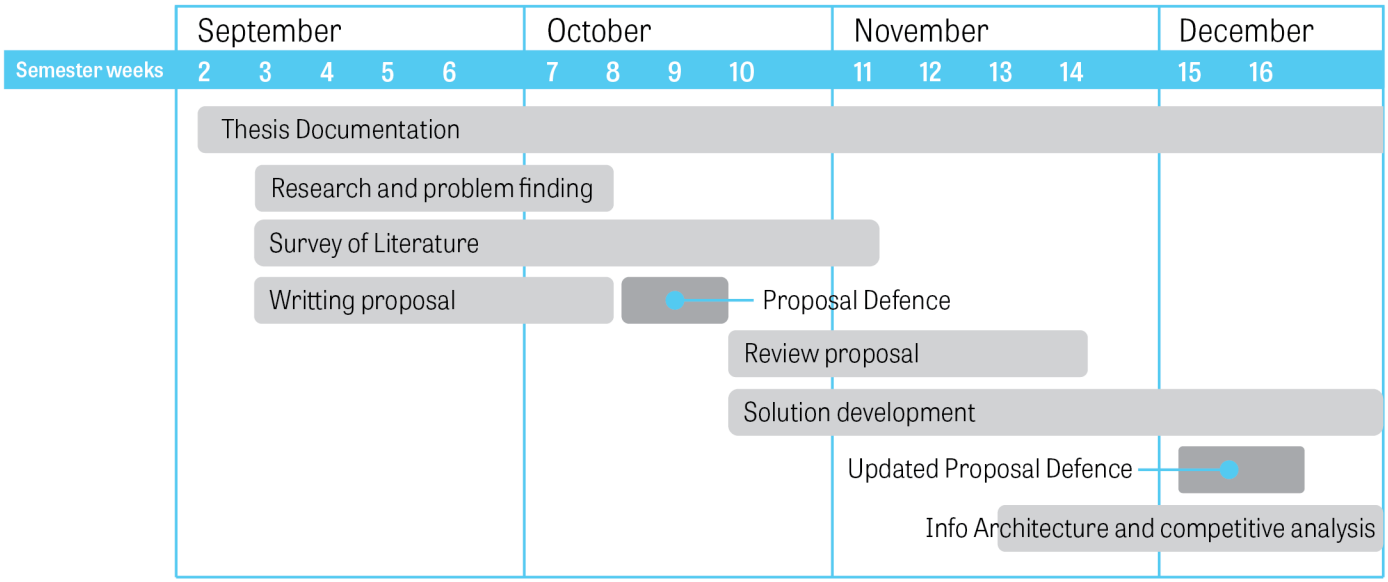
Projector for testing, price range between $100-300

Conference and competitions fees that starts from $100 and more

TIMELINE

Thesis timeline that present the ideal time of execution of the entire development of this project

THESIS THESIS TIMELINE _ FALL 2016



**January is winter break*

THESIS TIMELINE _ SPRING 2017

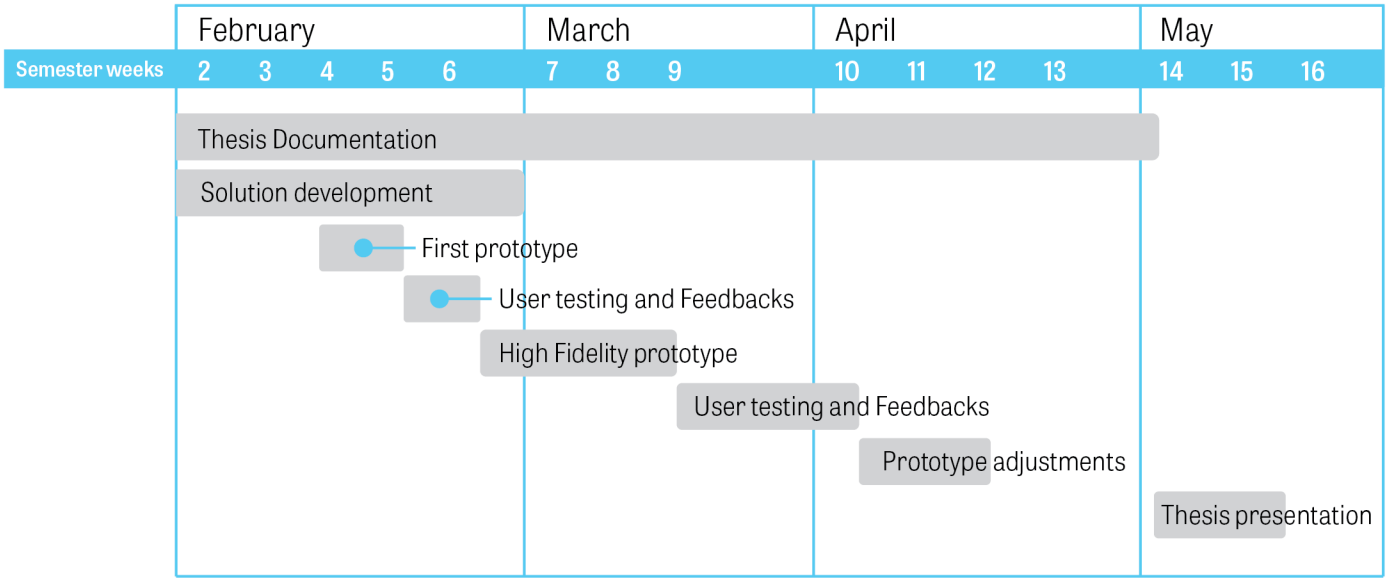


Figure 9. timeline of thesis proposal

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