Collaborative Visualization for Solar System Treks (CVSST)

Senior Design 2020-2021

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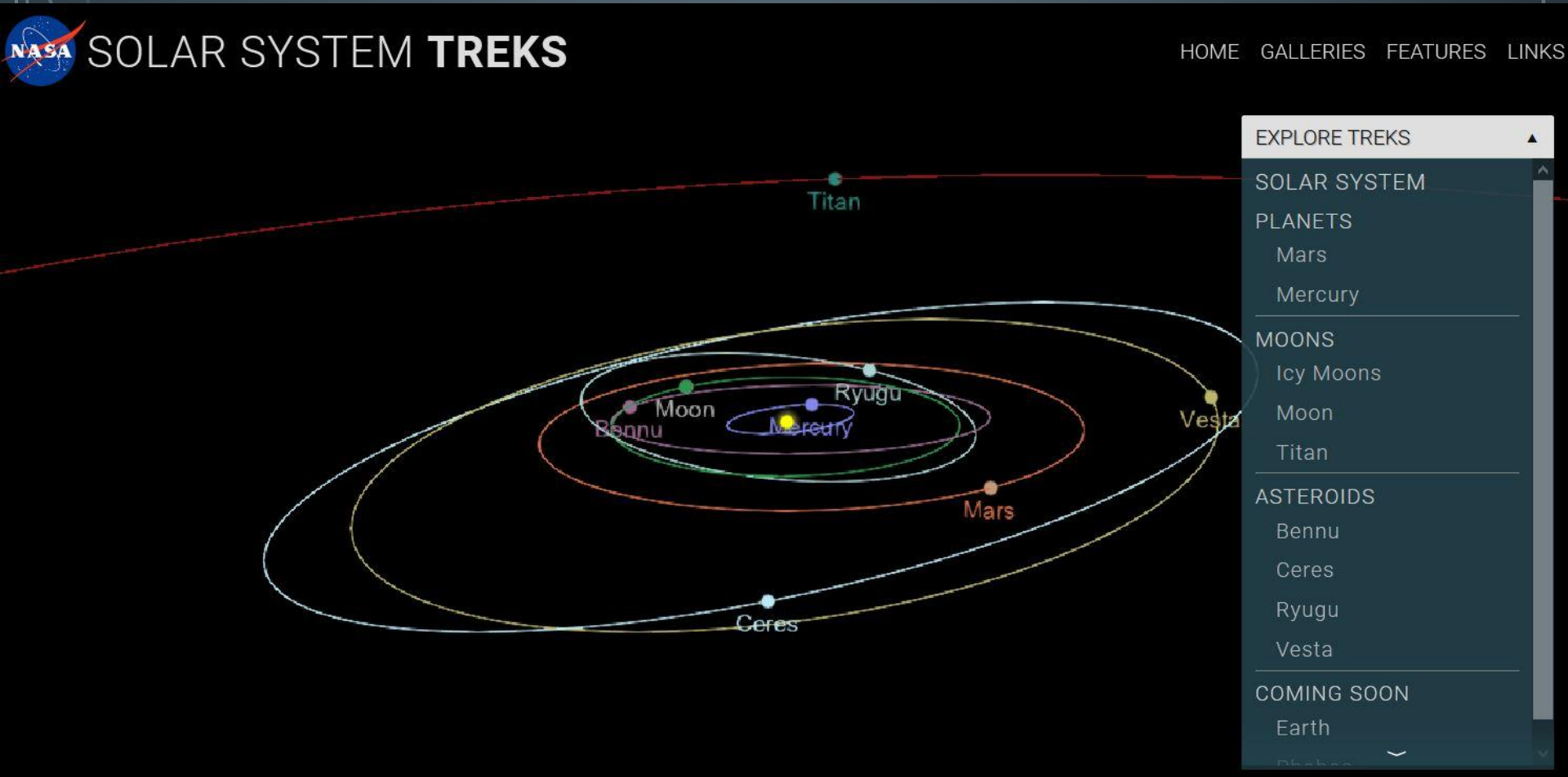
Project Advisor: Dr. David Krum
Liaison: Emily Law

Overview

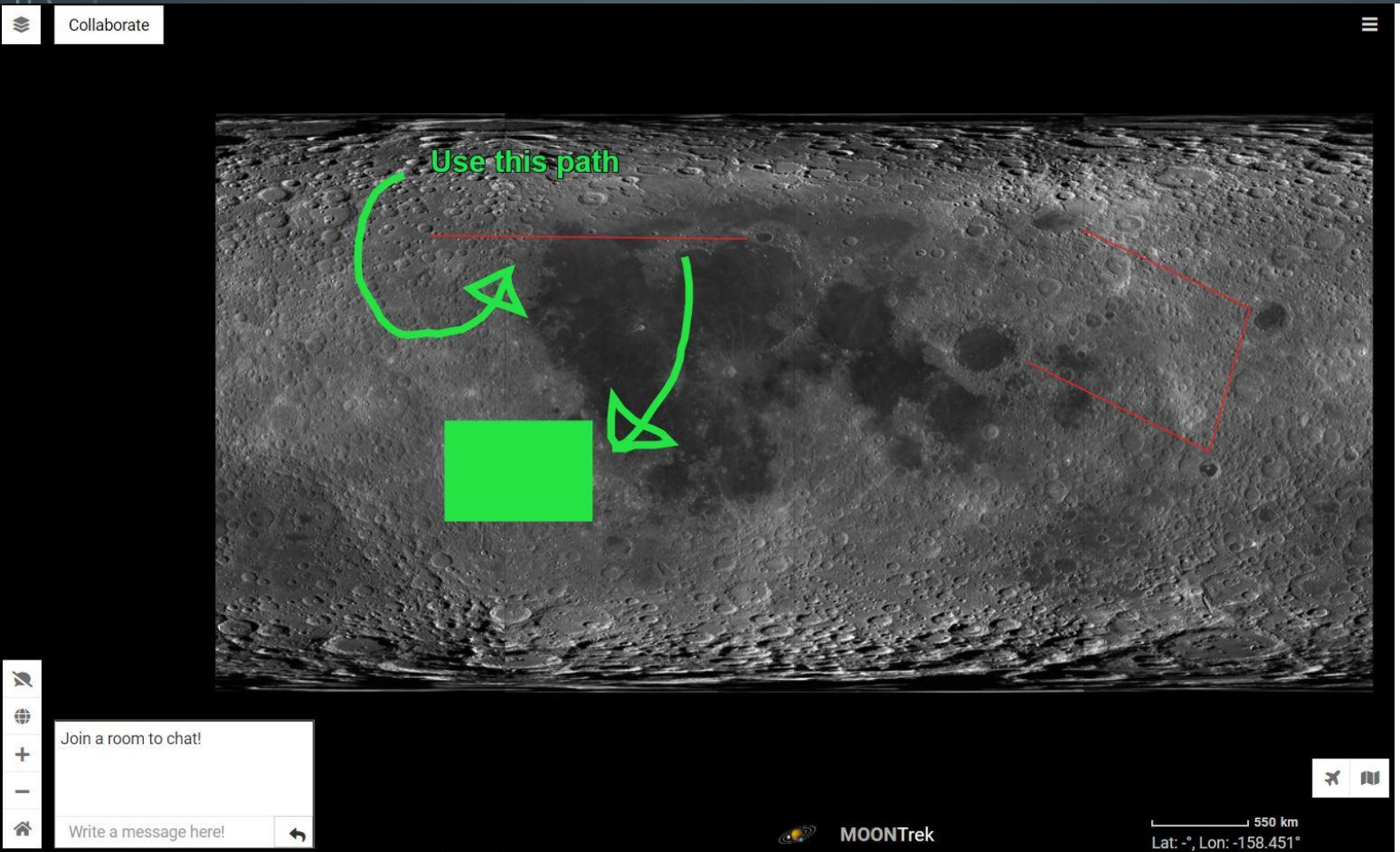
- Solar System Treks (SST)
  - JPL web portal.
  - NASA data of planets, asteroids, and moons.
  - Satellite photography and 3D terrain models.
- CVSST
  - Multiple users can examine the data together.
  - Collectively work on new ideas and projects in real time.
  - Integrate into SST.

Miguel Sanchez

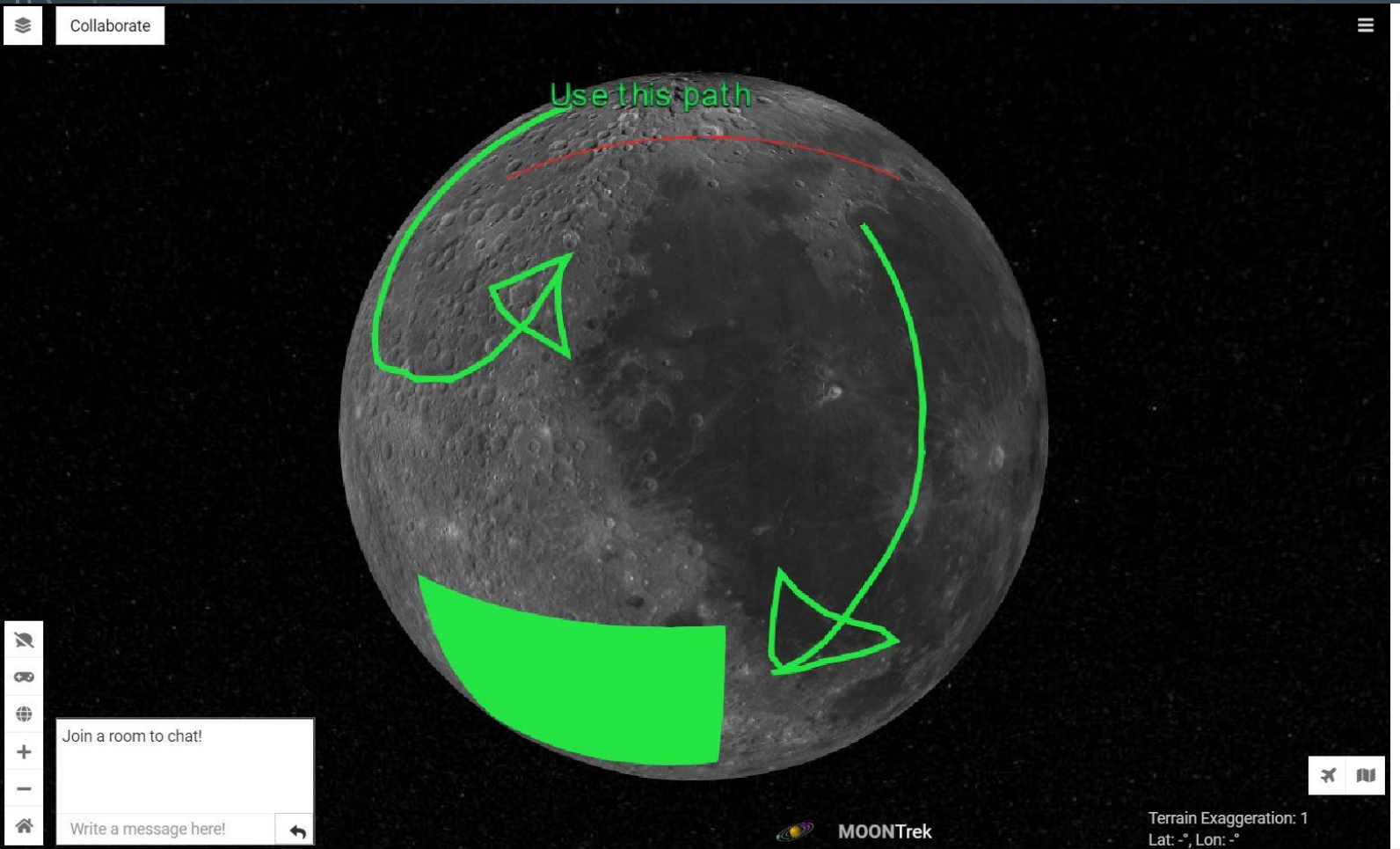
SST


SOLAR SYSTEM TREKS
HOME
GALLERIES
FEATURES
LINKS
EXPLORE TREKS
SOLAR SYSTEM
PLANETS
Mars
Mercury
MOONS
Icy Moons
Moon
Titan
ASTEROIDS
Bennu
Ceres
Ryugu
Vesta
COMING SOON
Earth
Titan
Ryugu
Moon
Bennu
Mercury
Vesta
Mars
Ceres

CVSST: 2D View



CVSST: 3D View



Outline

- Liaison & Team Introduction
- Project Planning
- Feasibility Assessment
- VR in Solar System Treks
- Avenues of Research Explored and Decision
- Software Requirements Document
- Project Timeline
- Personas, Use Cases, Scenarios
- Documentation
- Collaborative Session Functionality (2D/3D)
- Tools Module Functionality
- Conclusion & Demo

Miguel Sanchez

Introduction

- Sponsor: JPL
  - Liaison: Emily Law
  - JPL Team: Eddie Arevalo, George Chang, Richard Kim, Shan Malhotra
- Goal:
  - Develop networked visualization software to support collaborative markup of solar system terrain.

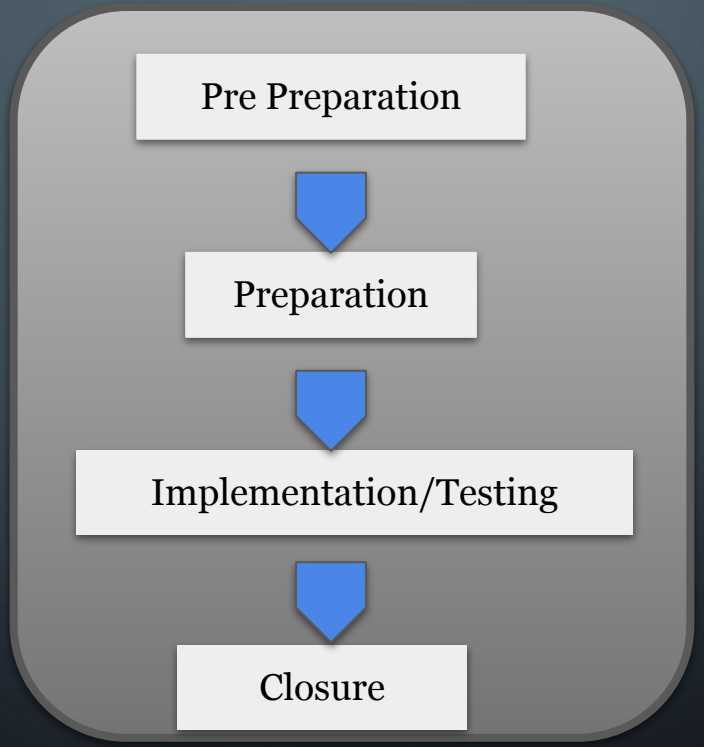
Miguel Sanchez

Introduction: Members and Roles

- Project advisor: Dr. David Krum
- Project lead: Montague La France
- Project co-lead: Stanley Do
- Customer liaison/requirements lead: Christopher Smallwood
- Architect lead: Abdullah Alshebly
- Documentation lead: Zipeng Guo
- Demo/presentation lead: Miguel Sanchez
- QA lead: David Tang
- Components (UI, backend, database): Jose Garcia, Odasys Soberanes, Johnny Lee

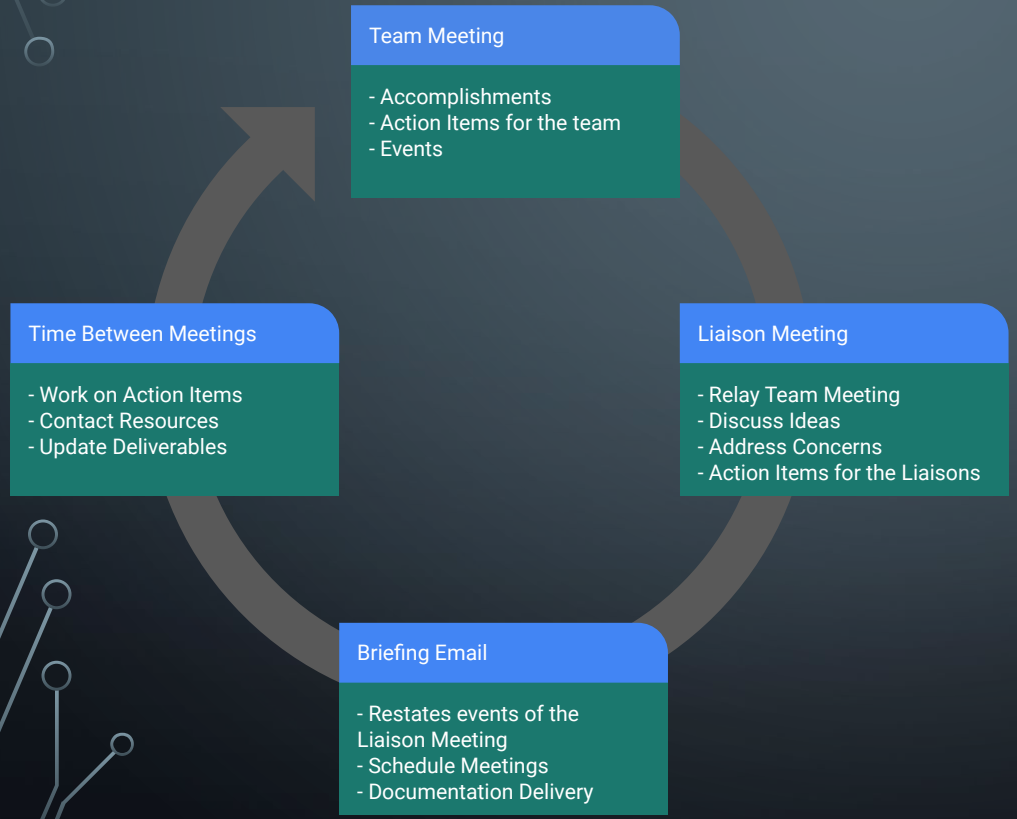
Miguel Sanchez

Project Planning



Christopher Smallwood

Project Planning: Communication



Proper Prior Planning Prevents a Poor Performance

Christopher Smallwood

Virtual reality (VR)

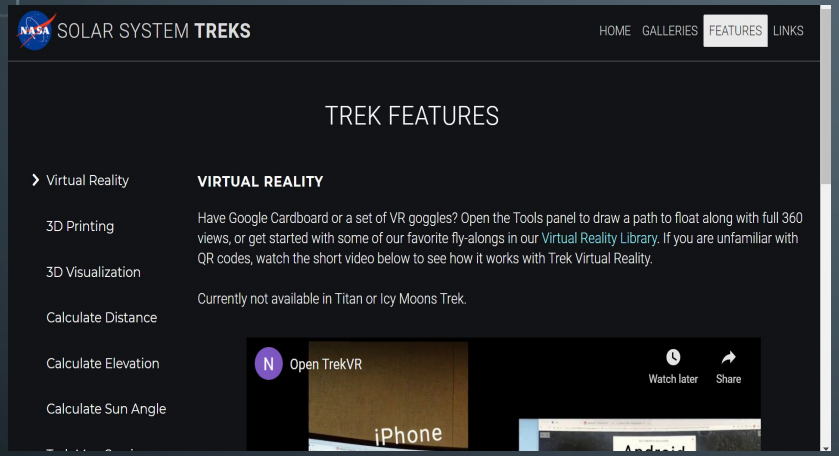
What is Virtual reality (VR) ?

- Virtual reality (VR) creates an immersive artificial world that can seem quite real.
- Through a virtual reality viewer user can have full 360 view.
- Virtual reality has many use-cases : Entertainment, Gaming, educational, or training tool.

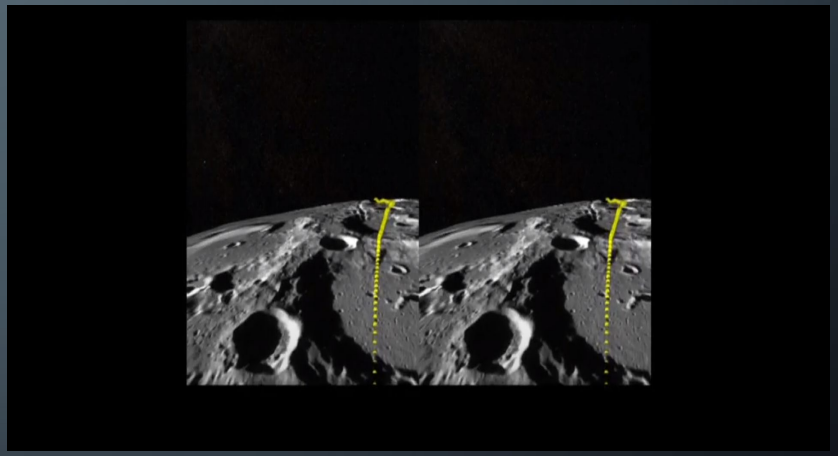
Abdullah Alshebly

VR in Solar System Treks

Trek VR (Features)

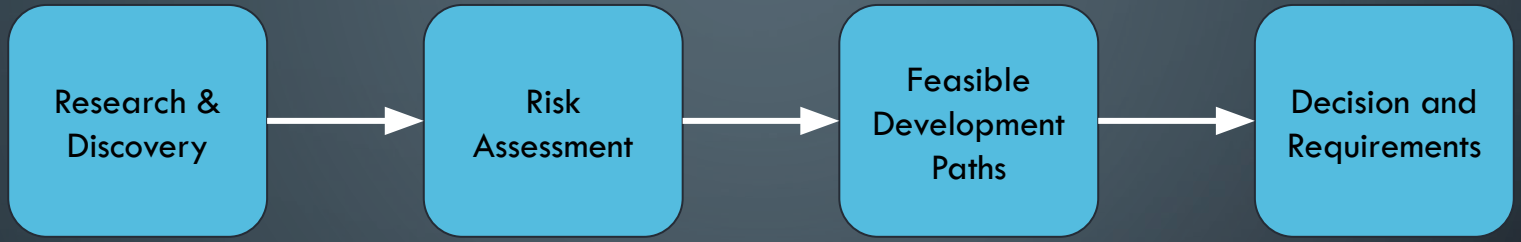


Trek VR (View)



Abdullah Alshebly

Feasibility Assessment



How does it help us?

1. Lets us understand the current software and technologies in use.
2. Keeps the amount of time on documentation and development in mind.
3. Builds a path towards a more successful project.
4. Helps the customer know our limitations and clarifies requirements.

Montague La France

Avenues of Research Explored & the Decision

Unity & VR Room

- Unity
  - Powerful platform.
  - Ease of manipulation for 3D data.
  - VR & AR quality support.
- VR Room
  - Existing Software to expand upon.
  - Utilized the Solar System Trek tools.
- Problem
  - WebGL
    - Does not support mobile while deployed on web.

Montague La France

Avenues of Research Explored & the Decision

Web Based Technologies

- Greater access to users and the public.
- Cesium
  - A powerful framework for 3D geospatial visualization.
- Esri (ArcGIS)
  - A geographic system for working with 2D maps and geographic information.
- Node Js
  - Utilized websockets
- Seamless integration with existing software.

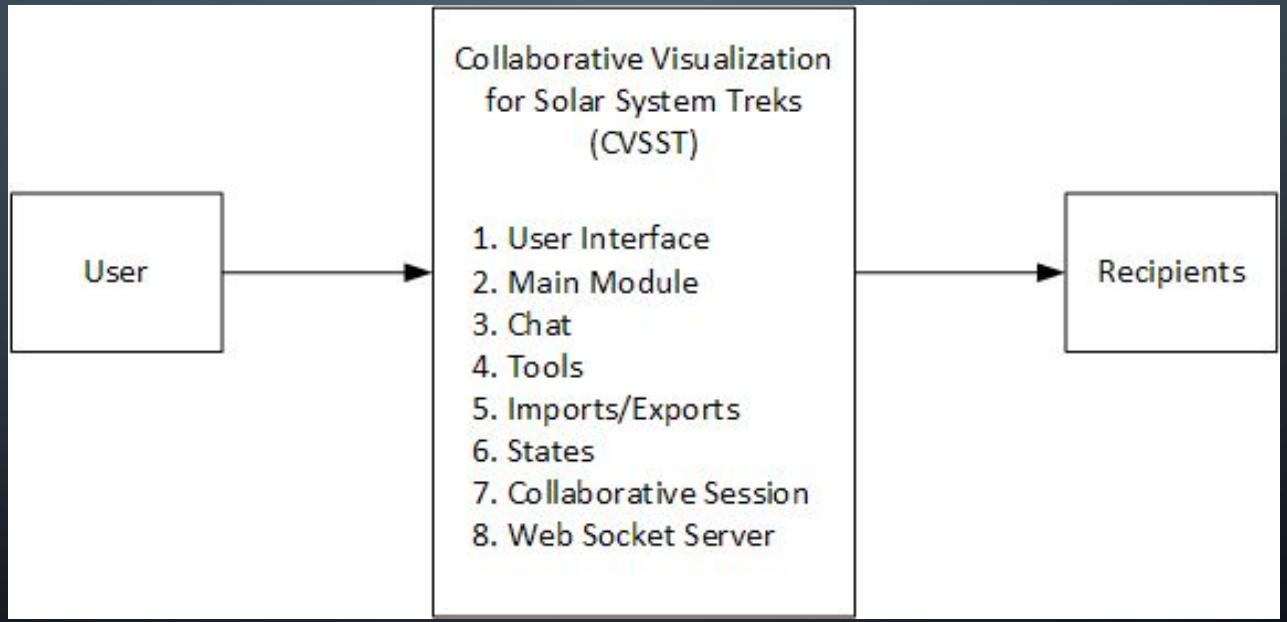
Software Requirements Document (SRD)

- A software requirements Document (SRD) includes in-depth descriptions of the software that will be developed.
- Drafted requirements from Personas, Use cases, and Scenarios.
- Revised document throughout the project.
- Functionality of the software.
- Future Team

Odasys Soberanes

Software Design Document (SDD)

DFD Level 0



Odasys Soberanes

Personas, Use Cases, Scenarios

- Represents different user types.
- Personas examples:
  - John is an ex-military, 35-year-old Mission Planner who works for NASA.
  - Nick is a 20-year-old college student with a love for space.
  - Tom is a 40-year-old high school teacher who is currently teaching a science class.

Zipeng Guo

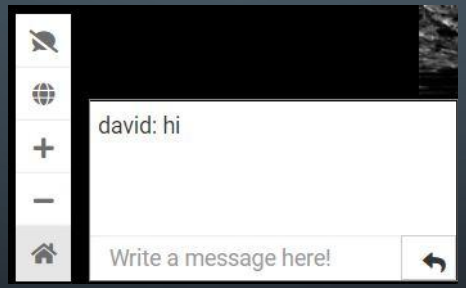
Personas, Use Cases, Scenarios

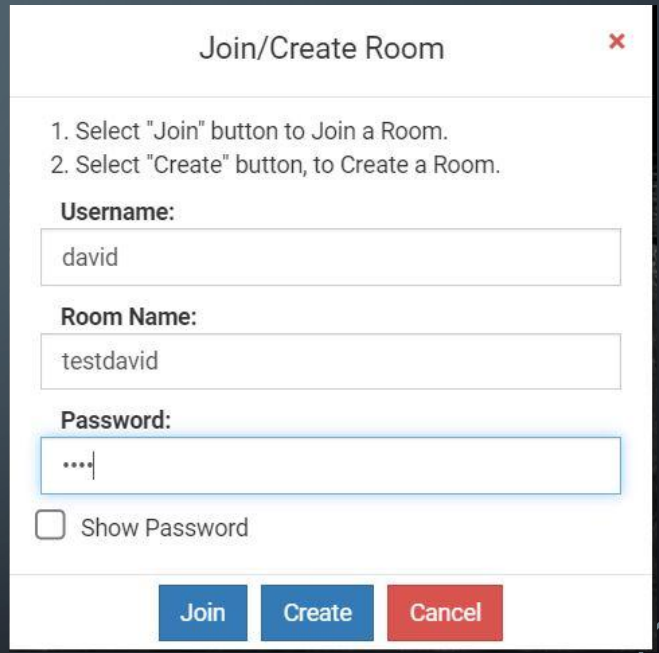
- Use Cases and Scenarios
  - Provides one or more scenarios.
  - Illustrates interaction between end users and the system.
- Importance:
  - Shows how our software might be used.
  - We can draft the requirements and Clarify about what we should do next.
- Example:
  - Nick is a 20-year-old college student with a love for space.
  - Nick and his friends want to be able to collaborate in a smooth way.
  - We provide: Create a room, share the waypoint location, Real Time Collaboration (Send Live Chat Messages).

Zipeng Guo

Collaborative Session Features

- Room
  - Create room
  - Join room with password
- Chat
  - Text





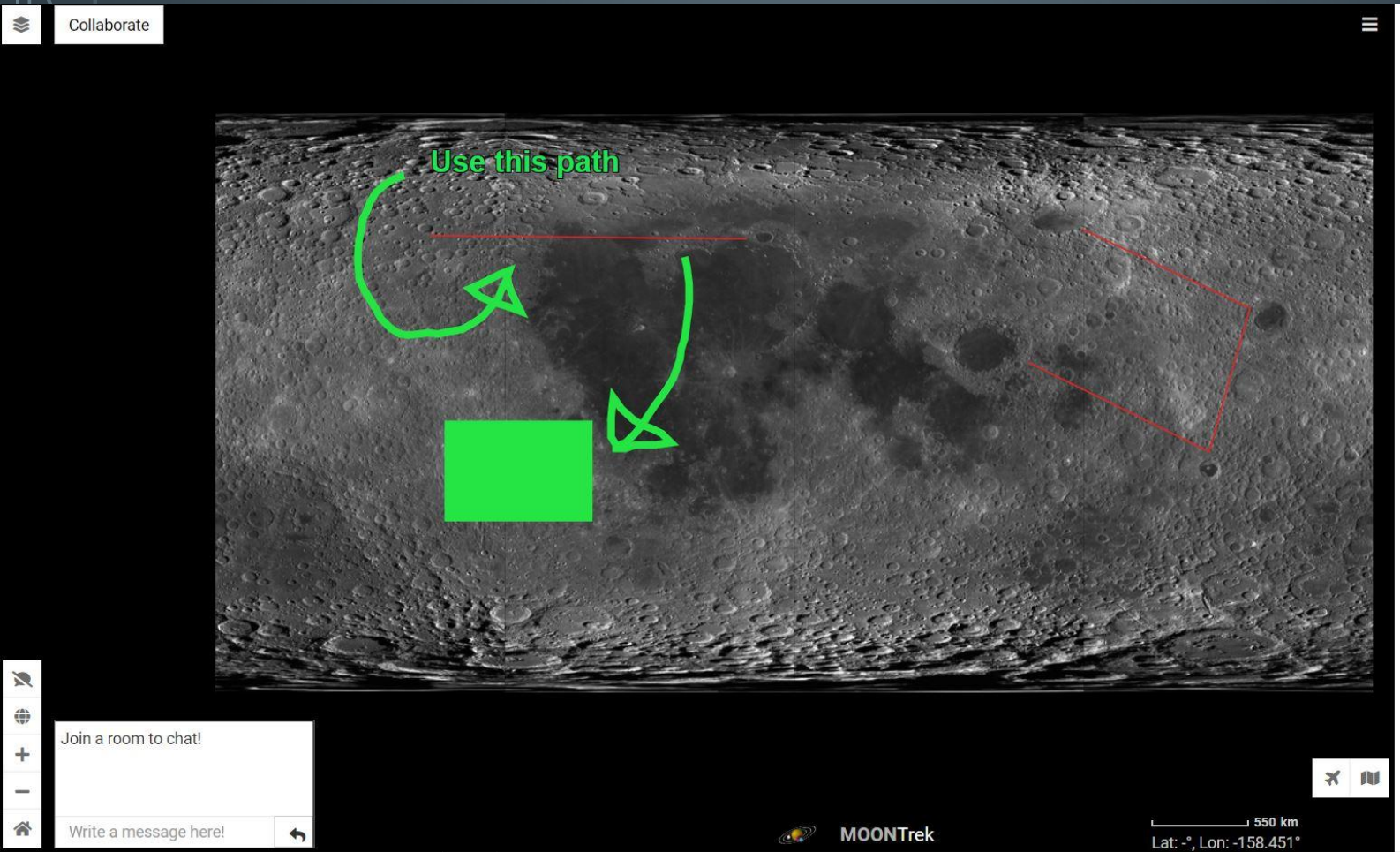
David Tang

Collaborative Session Features

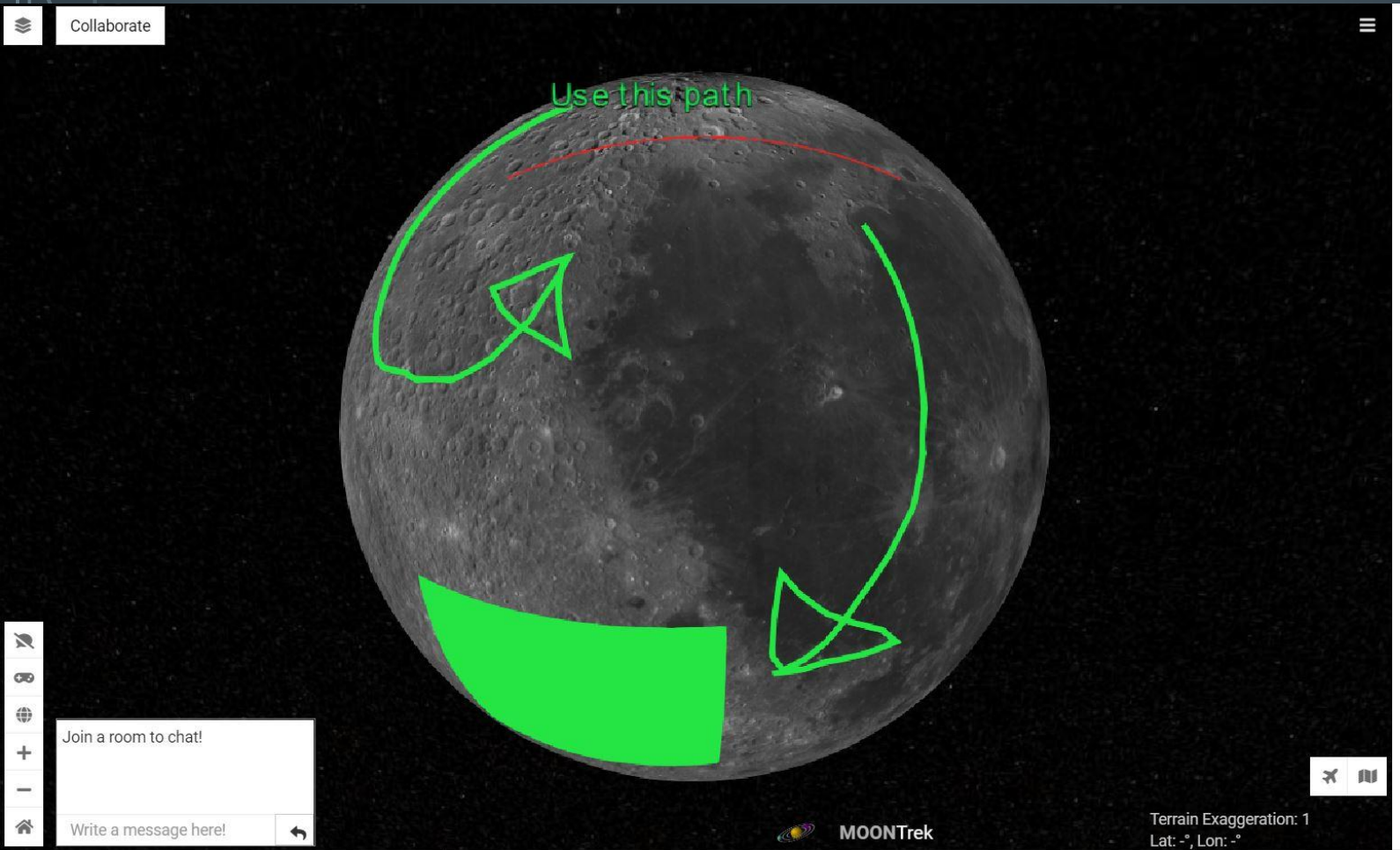
- States
  - States saves a copy of the planets data.
- Export a state
  - Creates a JSON file with data.
- Import a state
  - Upload a JSON file with data.

David Tang

2D Tools


Collaborate
Use this path
Tools
Current State:
Untitled State
Waypoints
Add a Waypoint
Add State
Delete State
Import
Export
Selected Tool:
Free Camera
2D Drawing Tools
Join a room to chat!
Write a message here!
MOONTrek
550 km
Lat: -°, Lon: -158.451°

3D Tools



Tools

Current State: Untitled State

Waypoints Add a Waypoint

+ Add State — Delete State

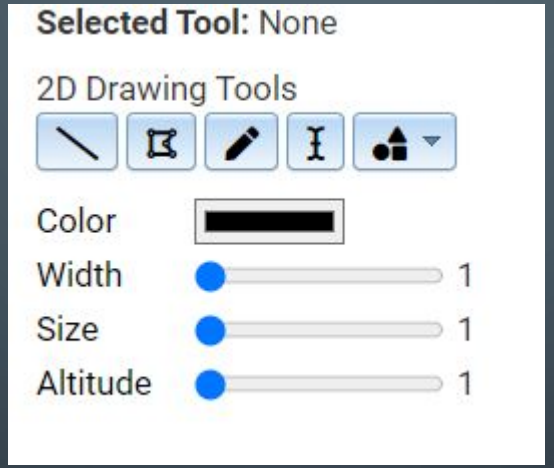
Import — Export

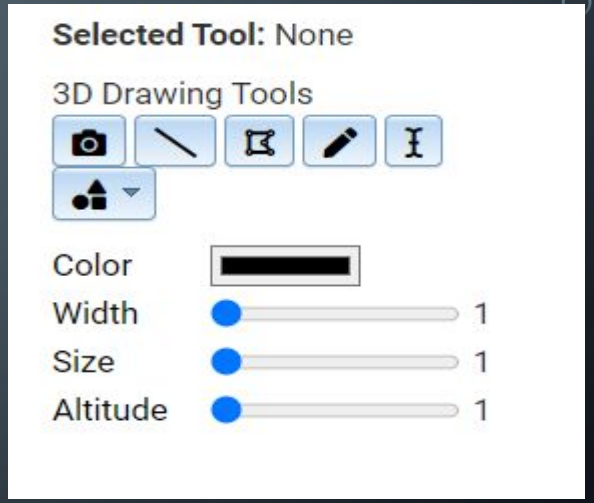
Selected Tool: Free Camera

3D Drawing Tools

Tools Module

- Tools
  - Line Drawing
  - Polyline Drawing
  - Freehand Drawing
  - Write Text/Point
  - Waypoints (3D only)
  - Free Camera (3D only)
  - Shape Drawings
    - Circle
    - Squares
    - Triangle





Jose Garcia

Tools Module: Improvements

- 2D drawings uses Esri's ArcGIS.
- 3D drawings uses Cesium.
- Missing curvature of lines in 3D
- Waypoints only works for 3D.
- Write Text/Point can be improve.
- Importing/Exporting States might have a few bugs.

Jose Garcia

Project Timeline & Next Steps

- Planning (8/28/20 - 10/30/20)
- Requirements (10/26/20 - 12/11/20)
- Design (11/27/20 - 1/5/21)
- Implementation (1/5/21 - 2/26/21)
- Testing (2/26/21 - 4/30/21)
- Closure (5/1/21 - 5/14/21)

Johnny Lee

Conclusion

- Technical Cliffs
  - The Dojo Toolkit is fairly outdated.
  - Older versions of software resulting in technical debt.
  - Difficulty with adapting to code.
- Passing the Torch
  - Expand on the collaboration features.
  - Implementation of collaborative VR/AR capabilities.
  - Implementation of a Database.

Stanley Do

Live Demo

Stanley Do