
TRILLIUM USA
Finding biosignatures on Mars
with an AI glider.

Introduction

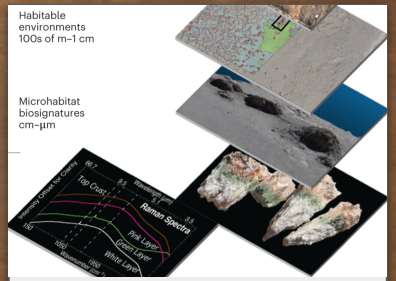
30 Min Simulation Activity

The following storyboard was created to apply to the first stage of NASA's MarsXR 2 Challenge. The story is set in the initial stages of human exploration on Mars.

It describes a concept for a multiplayer simulated activity within which astronauts interface with a Martian glider that is embedded with advanced sensing capabilities and onboard machine learning (ML) to identify evidence of fossilized life from an aerial perspective. The glider identifies fossilized bacterial mat candidates that prompt astronauts to explore regions and potential evidence of life within Mars' expansive tundra.

This simulation concept was inspired by a recent Nature article;

Orbit-to-ground framework to decode and predict biosignature patterns in terrestrial analogues



Orbit-to-ground framework to decode and predict biosignature patterns in terrestrial analogues

https://www.nature.com/articles/s41550-022-01882-x

The Storyboard screens were created within NASA's XOSS Unreal 5 environment with existing and custom created assets.

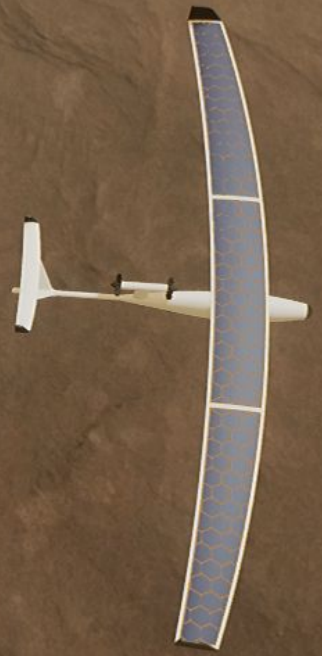
Assets utilized within this simulation

Existing:

- Unreal 5 Mars XOSS Environment
- Xemu Suit x2
- Centaur Vehicle

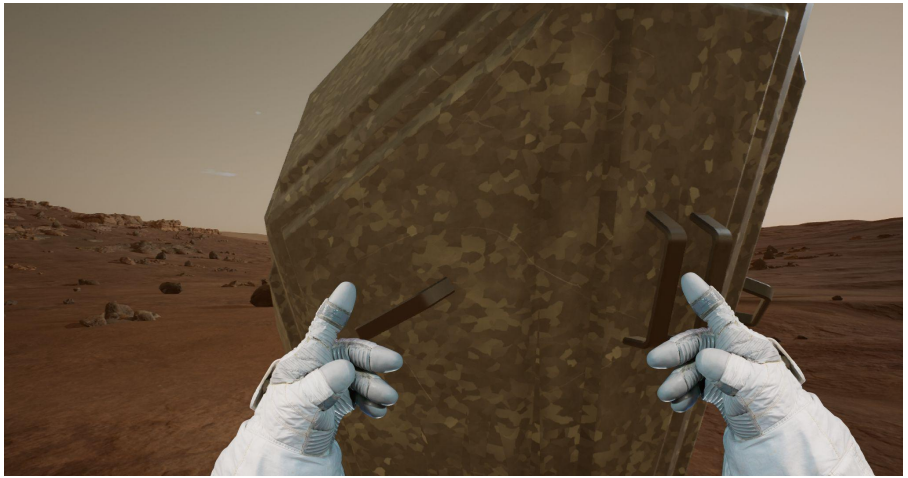
New:

- Martian Glider
- Launch System
- Landing system
- Dust Case
- Rugged Tablet (With Operations Interface)



1 - Open Dust Case 1 (Multiplayer Option)

Locate the martian glider in its protective dust case.



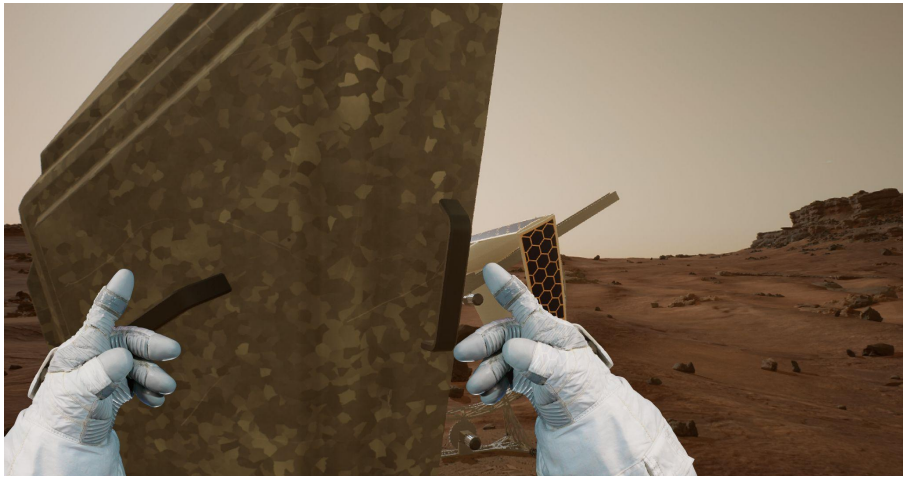
Find the handles and begin to open the dust case of the glider.

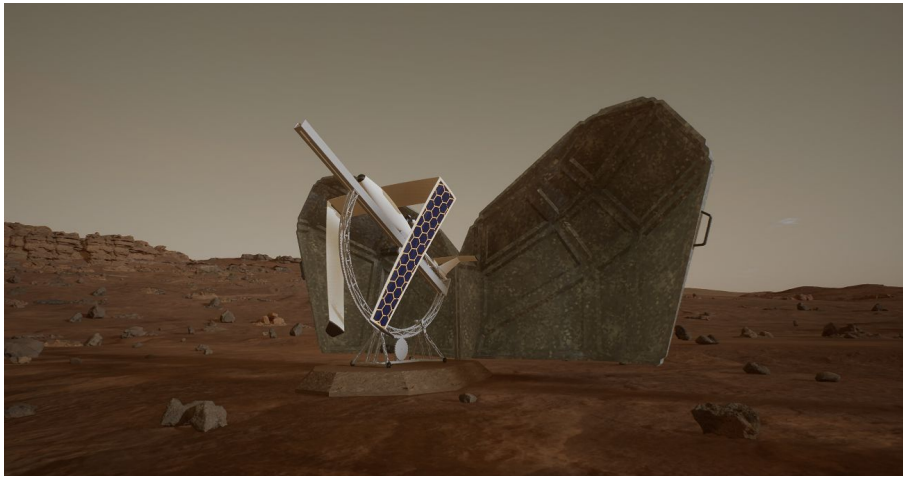
Can be completed alone or with a partner. The player/s are introduced to the difficulty of using space gloves.

Failure Point: Dust build up interferes with dust case

Success Metric: Handles gripped securely

2 - Open Dust Case 2 (Multiplayer Option)





Continuation of opening the dust case.

Synchronization of effort lifting the dust case is important. The activity can also be affected by visibility.

Completion of opening dust case to reveal glider.

Failure Point: Removing the dust case without getting dust on the glider

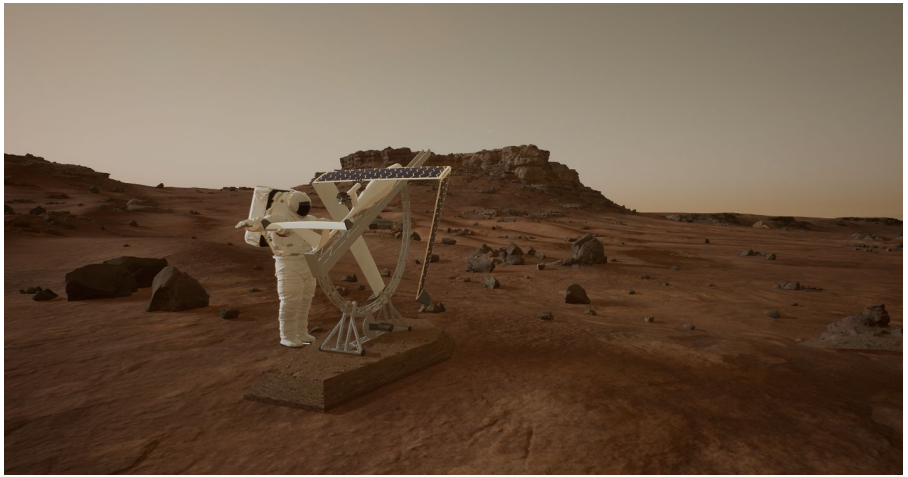
Success Metric: Case opens successfully

3 - Prep Glider 1 (Multiplayer Option)

Removal of the dust case from the area to allow the glider flight preparation to begin.

Player/s will have to remember where they placed this item.

Failure Point: Failure to preparation glider competently

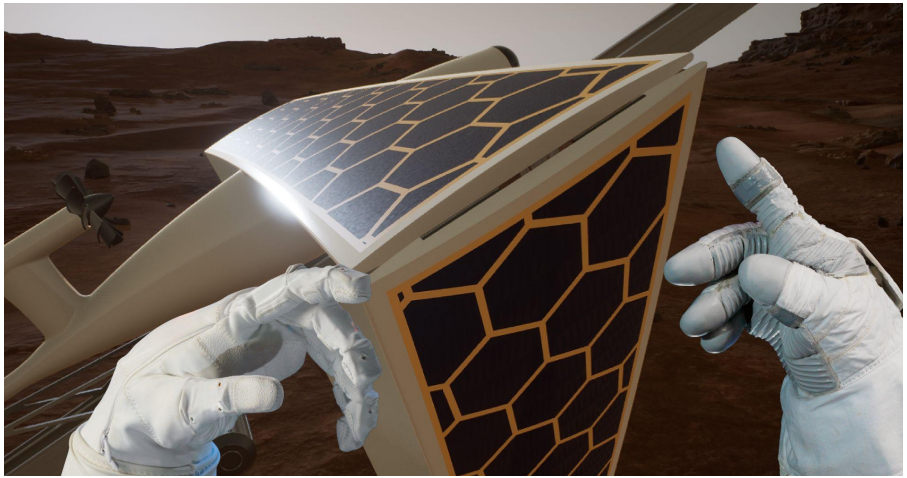


Preparation of the glider for flight.

Removal of electrostatic dust from camera unit and solar panels. Flight check of key systems (power, props etc)

Success Metric: Glider prepped and clear for flight

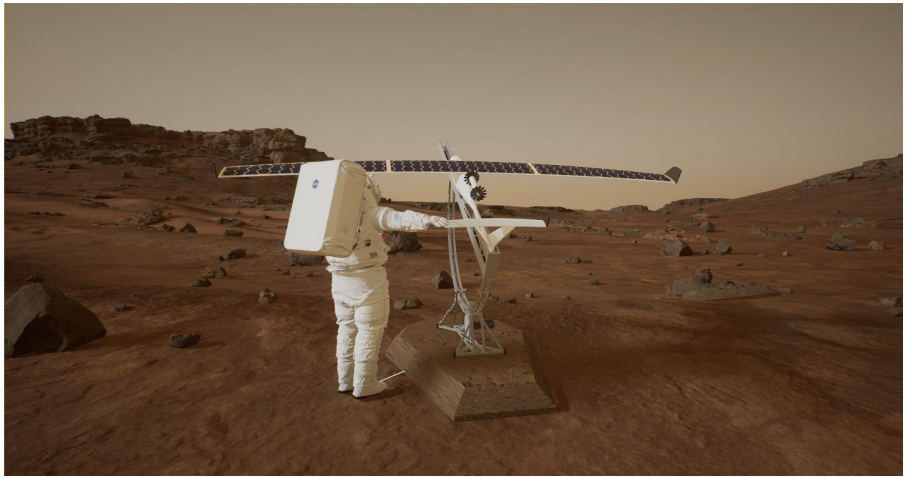
4 - Prep Glider 2 (Multiplayer Option)



Assembling the glider for flight.

Unfolding and securing wings, checking rigidity.

Failure Point: Wings unsecured and launch system engaged

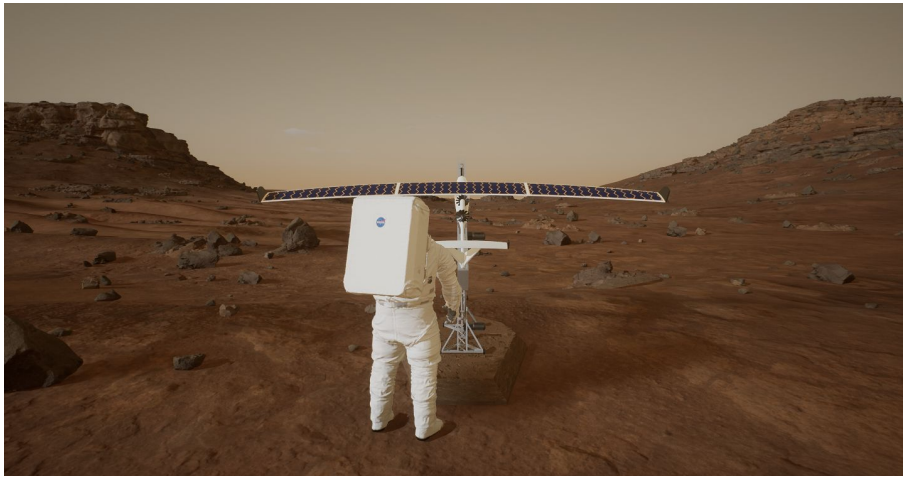


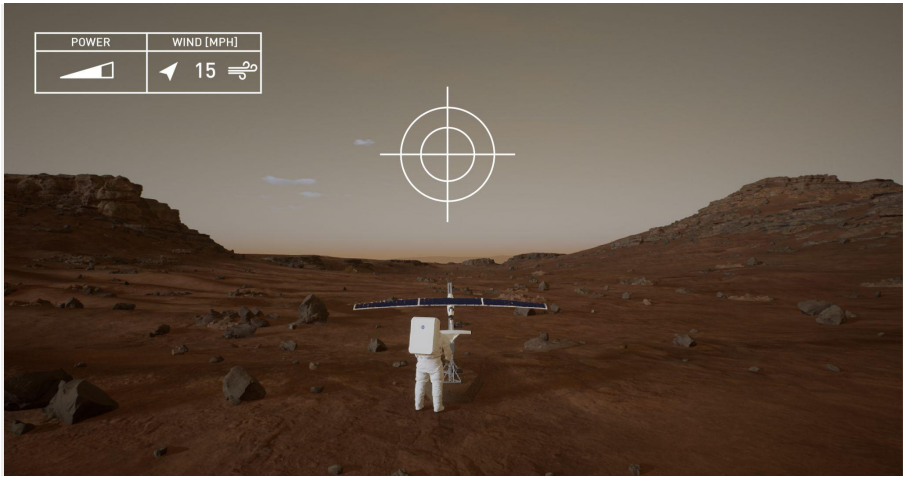
Final checks and charge of solar cells.

Propellers function, launch system and link with control tablet.

Success Metric: Glider and launch system prepped for flight

5 - Launch Glider 1





Enter glider launch mode.

Point glider to an area of open sky.

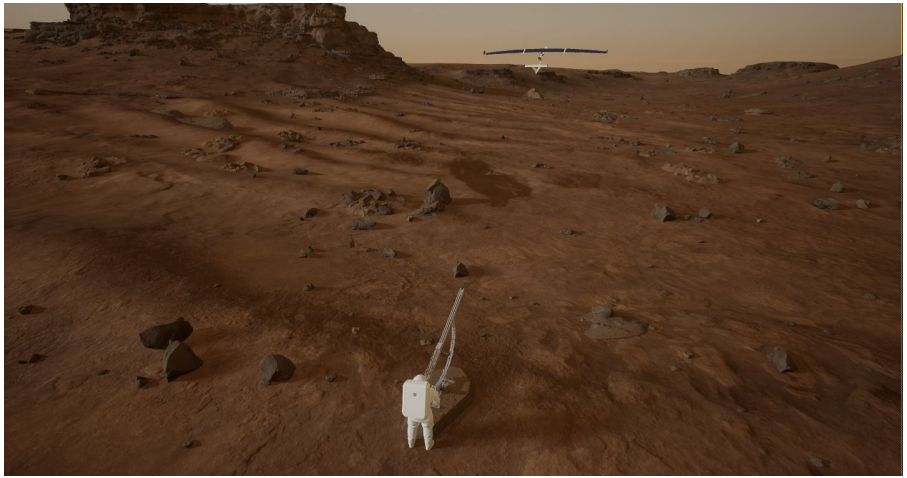
Aim glider taking into account current conditions.

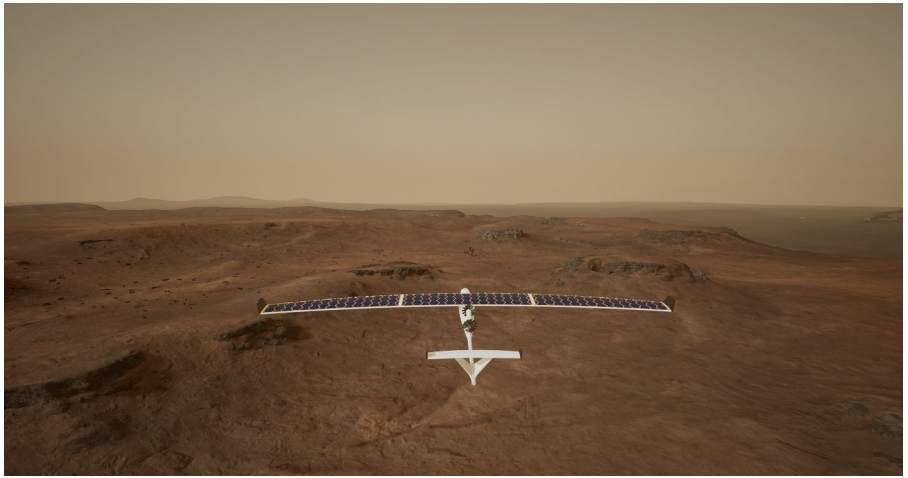
Golf game mechanics gamify this experience, failure at this stage results in a restart of the simulation.

Failure Point: Launch fails to achieve airspeed and fails

Success Metric: Launched glider

6 - Launch Glider 2





Glider launch a success!

Glider soars into the sky above mars.

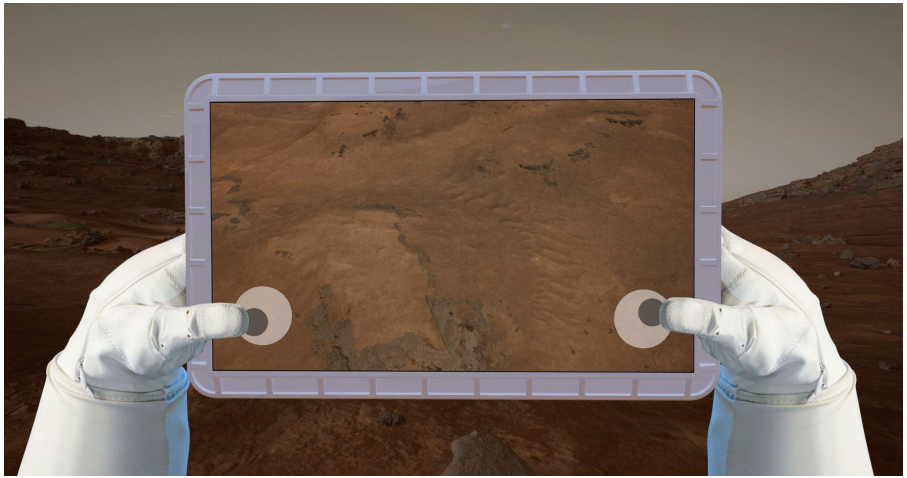
Panoramic views of Mars as the glider begins to be controlled by the Player

The player uses the VR controls to fly the glider.

Failure Point: Glider is crashed when player takes over controls

Success Metric: Glider remains in the air

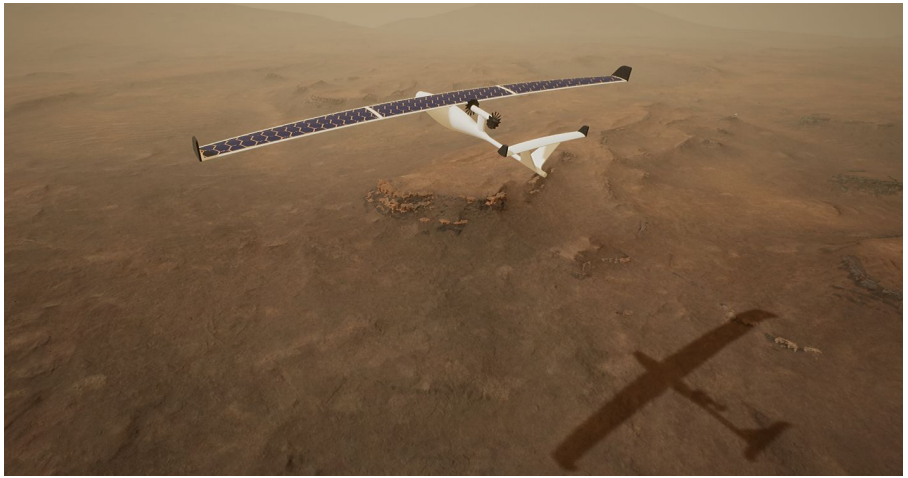
7 - Monitor Control



Introduction of tablet interface that controls the glider.

This tablet will be used throughout the simulation to view discoveries and command actions.

Failure Point: Glider control failure

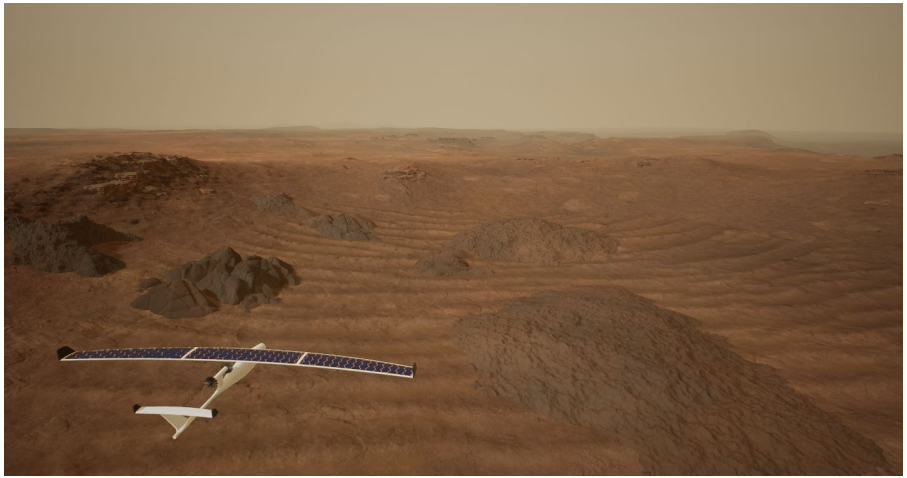


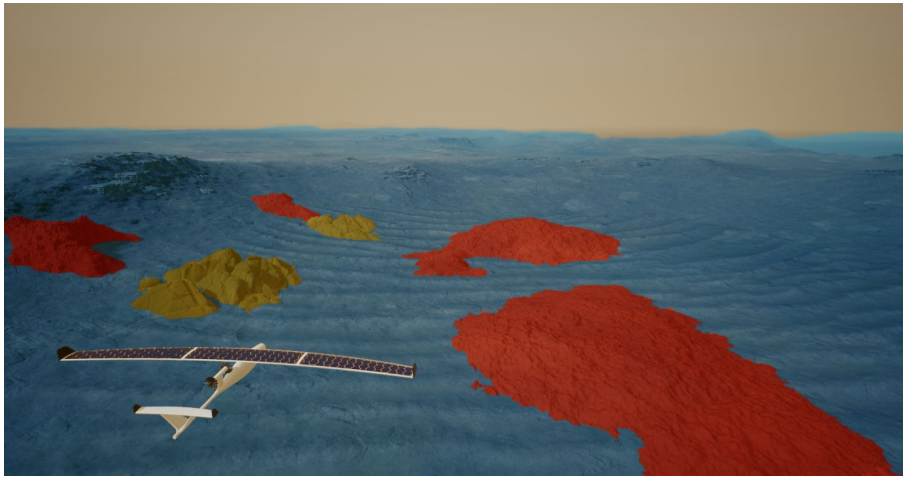
Player returns to 3rd Person view to explore Mars from the air!

The player looks for interesting ground formations.

Success Metric: Launched glider

8 - Find Bacterial Mats 1





Interesting ground formations identified.

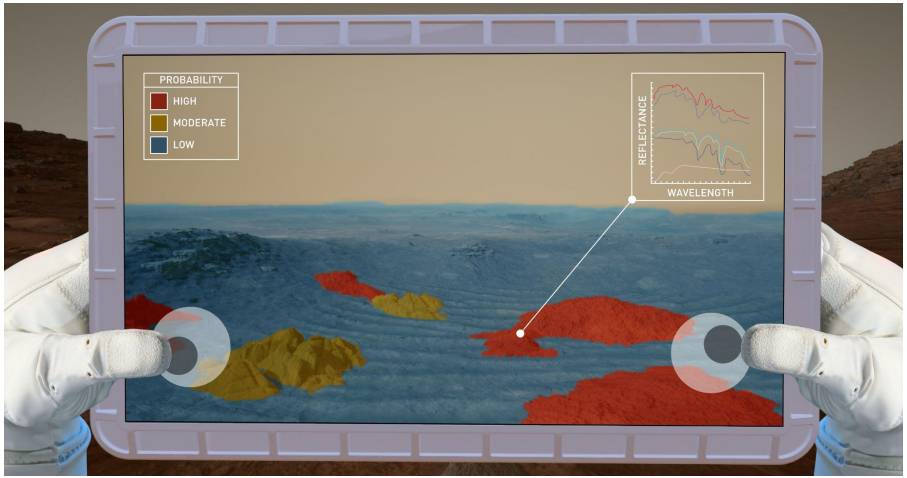
This prompts the player to turn on AI view.

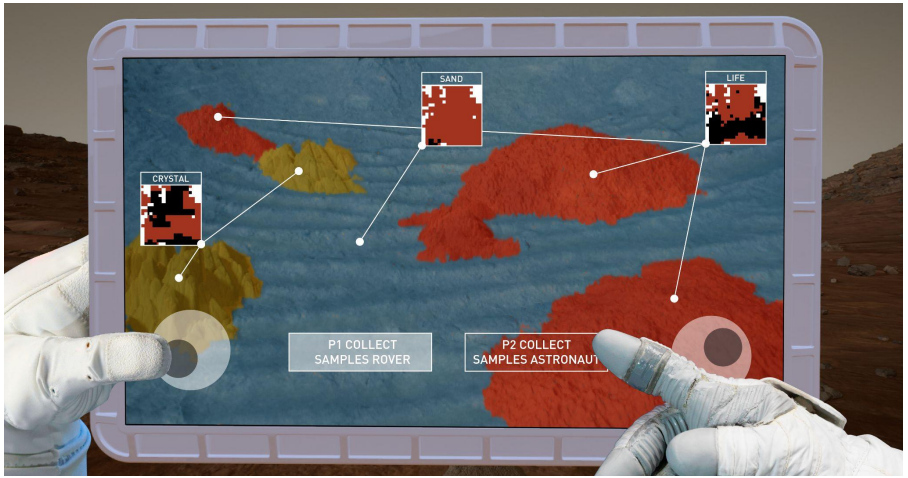
AI view reveals that there are areas that exhibit patterning that could be biological rather than geomorphic. (Fossilized bacterial mats).

Failure Point: Fossilized bacterial mats missed

Success Metric: Potential fossilized bacterial mats identified

9 - Find Bacterial Mats 2





Return to the tablet to analyse the observation.

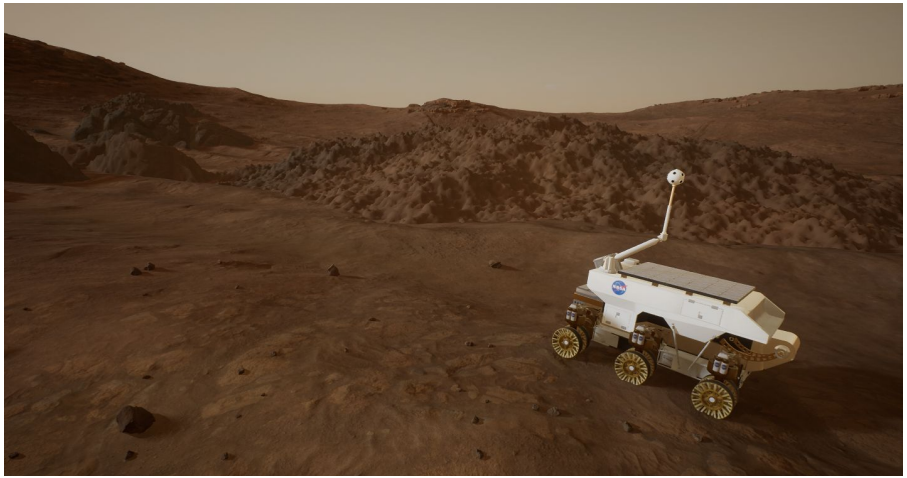
Tablet view explains what has been found and overlays scientific analysis of view.

Observation is categorized and a command to conduct a rover exploration is given, identifying key landmarks and geofencing vital sample zones.
Glider is put into autopilot to allow for the next stage.

Failure Point: Managing glider range

Success Metric: Follow-up mission initiated

10 - Ground Truthing Rover / Astronaut (Multiplayer Option)



Player drives the rover to site of potential fossilized bacterial mat and takes more detailed imagery.

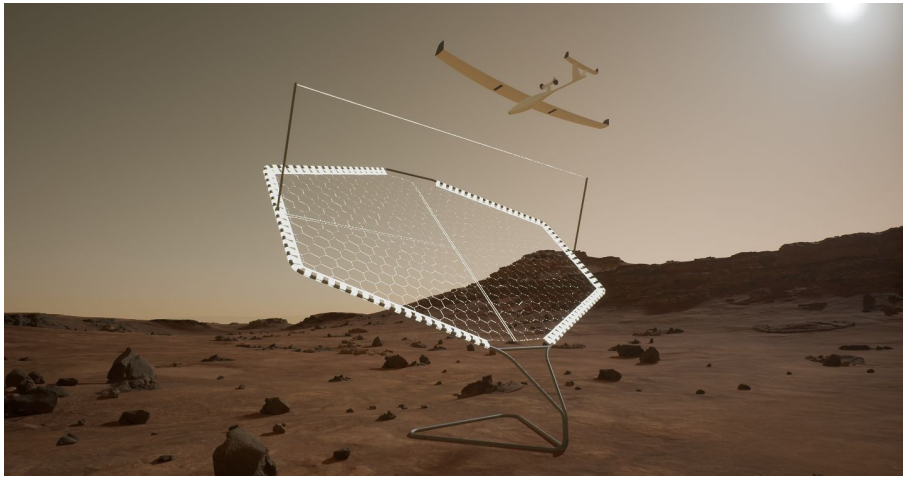
This interaction could be gamified with placing of a beacon.

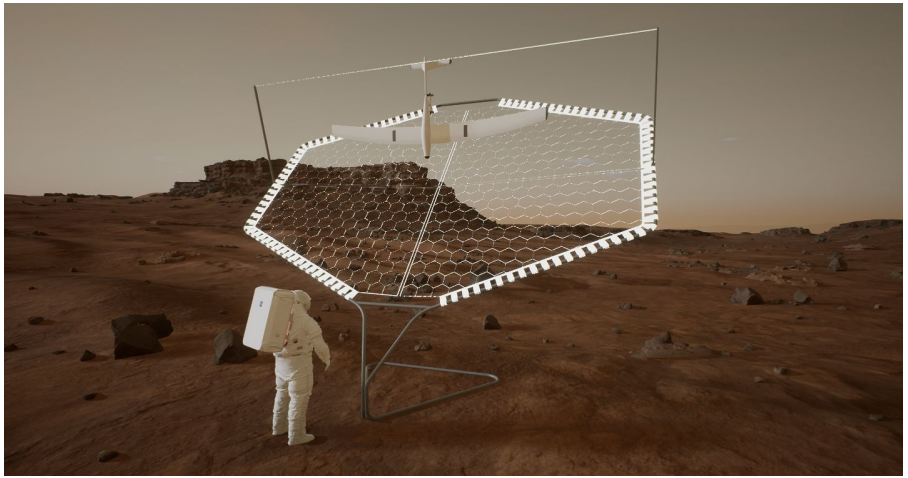
Player arrives at the site to see the discovery on the ground and carefully collects a sample without damaging the site.

Failure Point: bacterial mats are damaged by rover

Success Metric: Sample taken!

11 - Glider Landing (Multiplayer Option)





Guide the glider back to launch position to be Landing System.

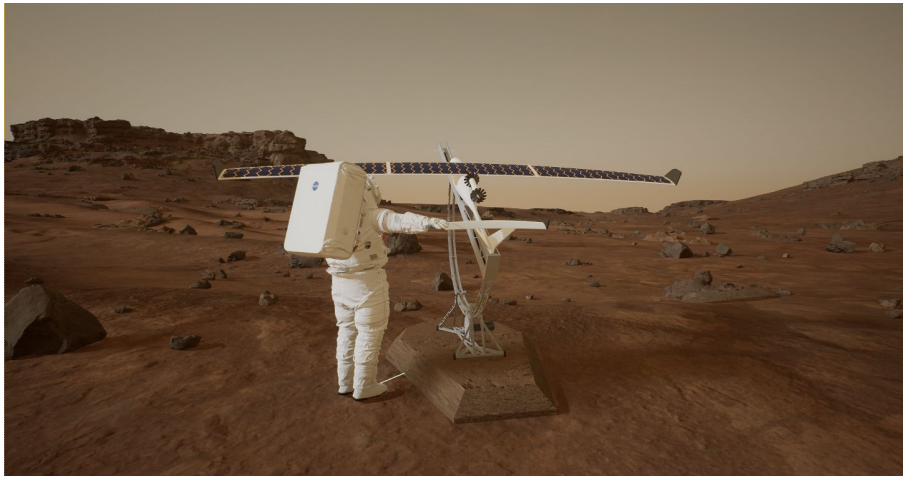
Could be gamified by a player setting up Landing System in a suitable location.

Glider is caught successfully, Player retrieves the glider.

Failure Point: Glider misses landing system

Success Metric: Glider caught successfully

12 - Secure Glider (Multiplayer Option)



Glider is Secured on launch system and packed down.

Check for damage and battery charging.

Failure Point: Glider pack down remains incomplete

Glider is protected from oncoming dust storm with the installation of the dust case.

Success Metric: Protected glider