Project Title*

Helios Escape

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Provide a high-level summary of your project*

<Summary>
We design a web-based game employing WebGL to engage the players in adventures of space travel while learning knowledge and tackling issues about modern spacecraft propulsion. This game comes with several threads through which to explore the cosmos and challenge problems in cosmic travel. The current setup involves 6 brilliant propulsion engines and 6 magnificent moons, planets or stars in 17 scenarios for the player to complete a cosmic journey of his choice. In summary, this game helps encourage the public, especially the kids, to mobilize their imagination and curiosity based on modern knowledge, and learn to dream big and dare to fail as the universe is full of opportunities.

Describe how your project addresses this challenge*

<How We Addressed This Challenge>
[Introduction]
As a player, you are a space traveler driving an advanced spaceship. You first need to collect various components of engines among planets in the Solar System in order to build five cutting-edge engines. After completing all the engines, you will earn the Warp drive, with which you could finally escape from the Solar System traveling into deeper space.

[Motivation]

We wish to utilize the power of gaming and 3D drawing for bringing the public closer to space travel involving high-tech aspects of the propulsion technology. Hopefully this game could inspire people for deeper imaginations towards the outer space in an entertaining way.

[Concept]

(a) Education
Through the game, we present the players with physical theorems and key knowledge about spaceships of different engines. We demonstrate the current obstacles to engineering development and thus the necessity of breakthroughs in propulsion technology. In particular, we wish to motivate young people towards science especially into aeronautics and astronautic engineering.

(b) Inspiration
We utilize a series of games in different scenarios in order to inspire the players in problem solving and propulsion technology. Our fictional 3D environments would also help innovate their imagination in interstellar traveling.

(c) Future perspectives

We introduce the latest developing concepts including the nuclear fusion and space warps with simulated functions and drafted structures.

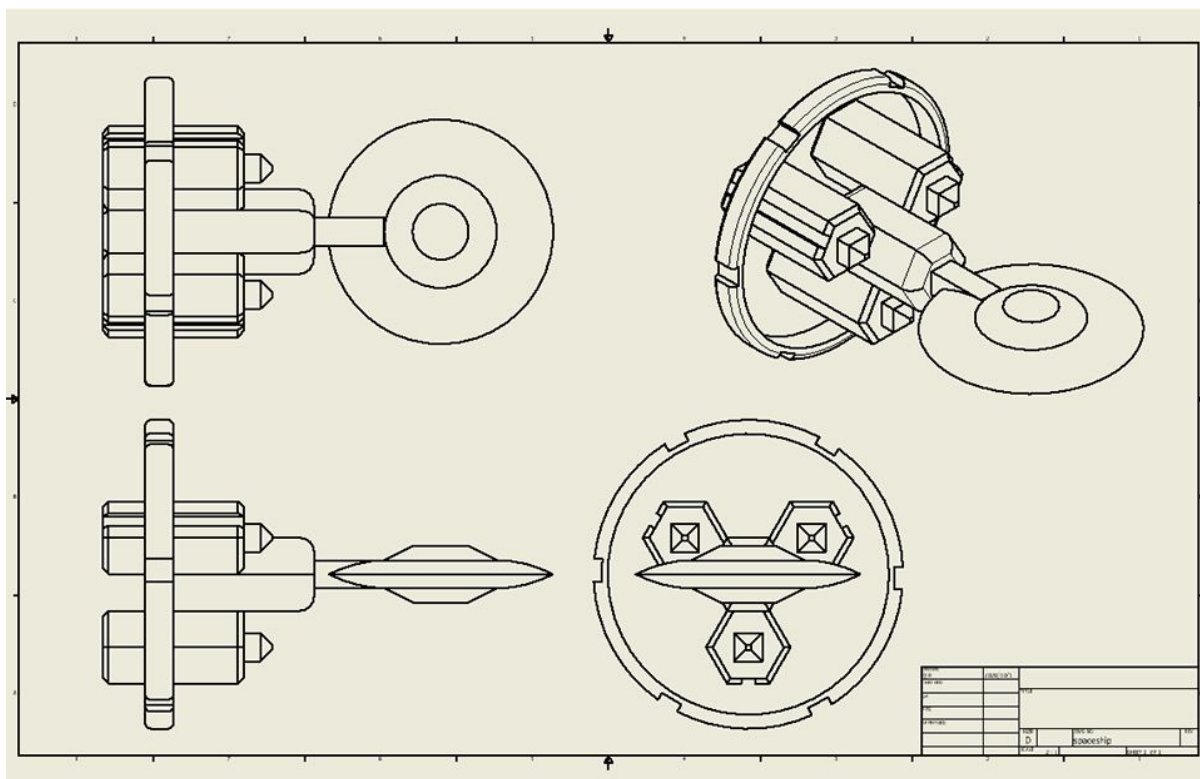## [Design]

(a) Environment setup

Our main stages involve one star and 7 planets. The star is Toliman at Alpha Centauri and it is the star closest to our solar system. The 7 planets are Mars, Jupiter, Saturn, Uranus, Neptune, Kepler 69c and K2-18b, the last two of which are known exoplanets with habitable environments similar to the Earth.
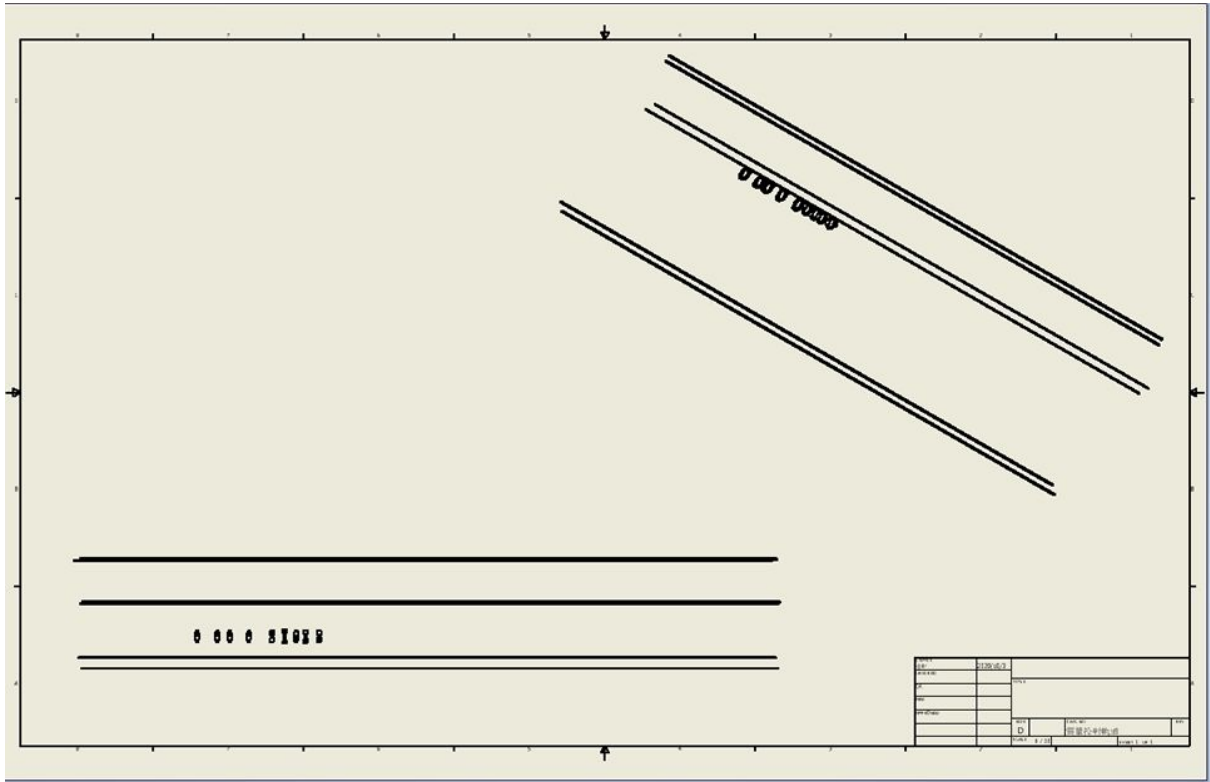
(b) Game scenarios

On each planet you learn knowledge for various types of engines and for the environment of the planet. After the lessons you need to collect parts of engines and then build them up! You may be involved in other additional related missions.

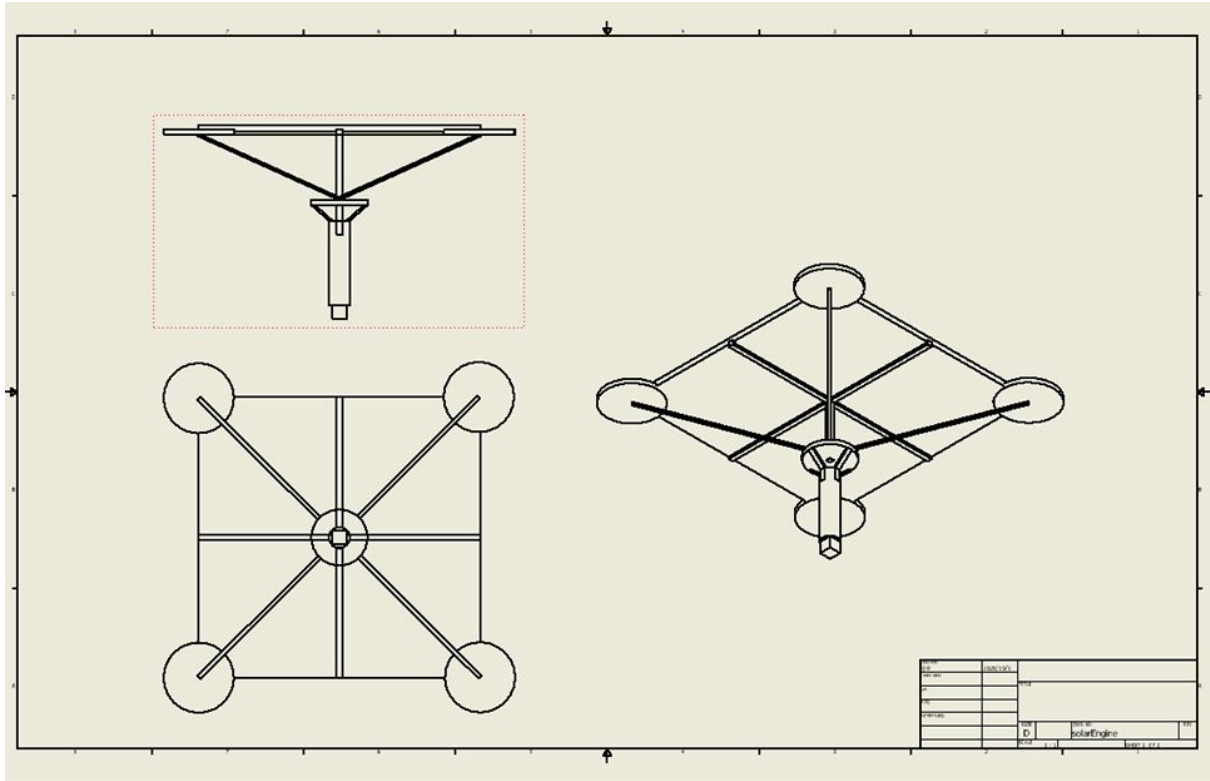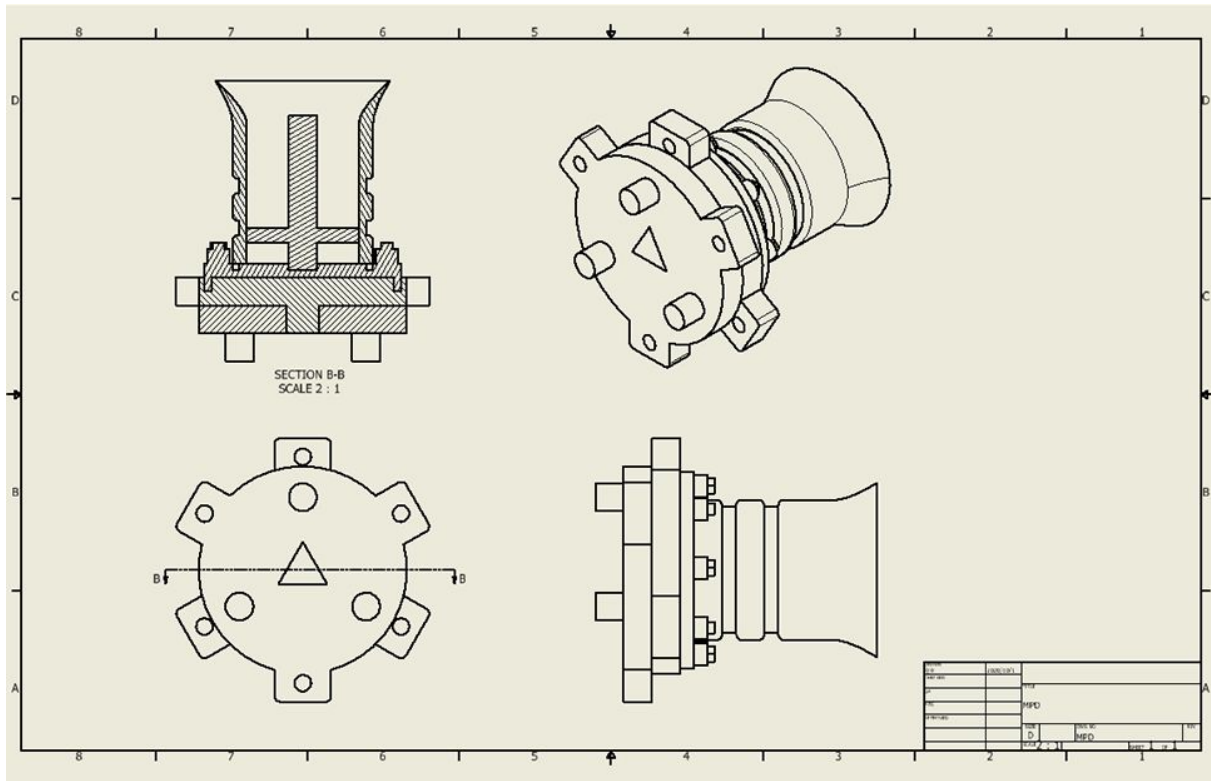(c)   3D models of the spaceship and 6 different engines created by Inventor
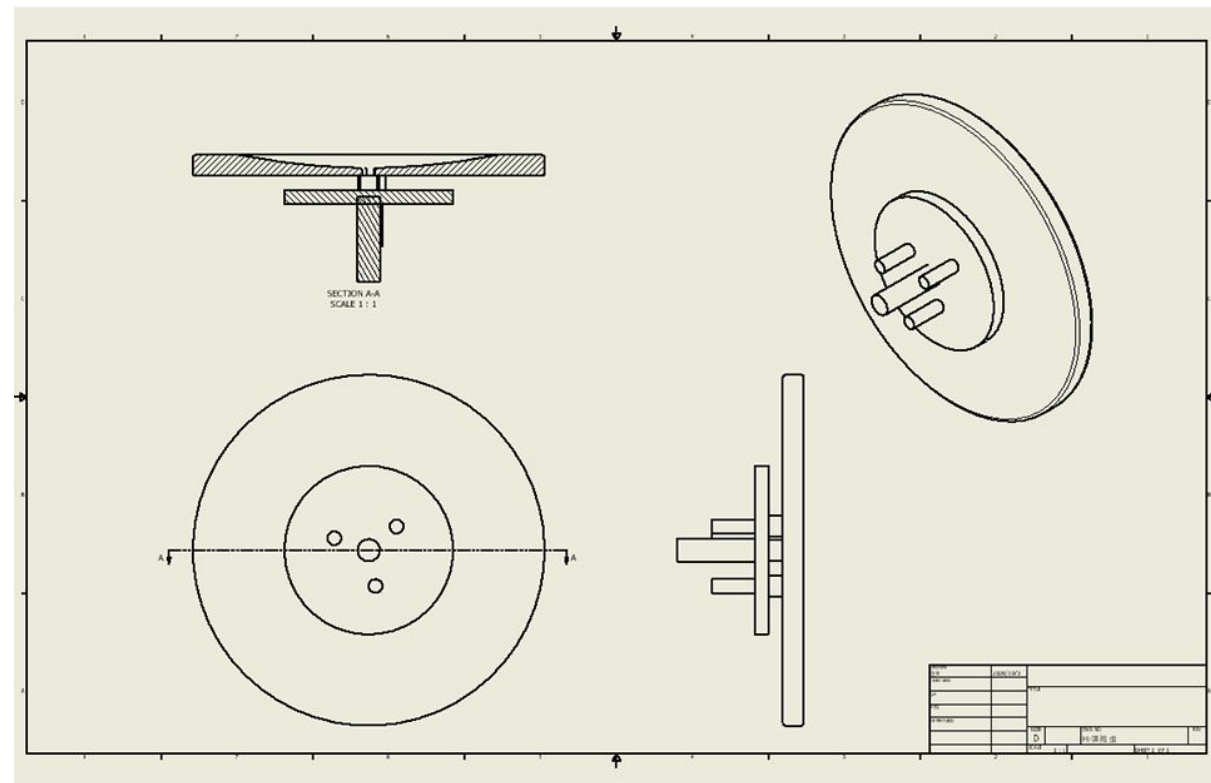
Spaceship

Mass Driver

Solar Sail

MPD

SECTION B-B
SCALE 2 : 1

NPP Thuster

SECTION A-A
SCALE 1 : 1

Bussard Ramjet

SECTION A-A
SCALE 1 : 1

Warp Drive

SECTION A-A
SCALE 1 : 1

[Prospect]

<Improve the data>

In future we plan to utilize the NASA date more accurately, creating a more realistic and instructive environment.

<Game optimization>

We will improve on our UI by, for example, adding more scenes and missions. With the current setup, it is also straightforward to expand "our" cosmos in the game.

<Innovative engineering>

Our efforts so far have mostly focused on gaming engineering and design, and with the current framework we could easily add in more engines of other types and make the spaceships more realistic and delicate.

<Virtual Reality & Augmented Reality>

Our game is 3D-based and thus ready for the expansion to VR or AR. Its cross-device portability is very high.

<Promotion and sustainability>

In the near future we plan to cooperate with gaming companies and educational institutions for sustainable maintenance and development, keeping the game free to use for the public.

Describe how you developed your project*

<How We Developed This Project>

[Background]

In 1977, NASA launched the Voyager 2, a space probe, to study the outer planets. After decades, Voyager 2 has accomplished many pioneering missions for humans. It flew by Jupiter, Saturn, Uranus, Pluto, and their moons, sending precious data back to Earth. After exploring the planets in our Solar System, Voyager 2 kept on traveling out of the Solar System. In 2007 it passed the termination shock and entered the heliosheath. In 2018 it left the heliosphere and entered the interstellar medium. Although 43 years have passed, Voyager 2 is still wandering around the Solar System. Some expect it to reach the inner edge of the Oort cloud in 300 years and spend tens of thousands of years to go through it. Our distance to the outer edge of Oort cloud is about half of the distance to the Kepler-69c, the star closest to our Sun. Such timescales and distances seem to be too large to be realistically considered for any existing lives on Earth. Nevertheless, modern technology is already making some changes. New advances in physics and engineering have been cutting the long way shorter day by day. For example, a probe using the solar sail as its propulsion would need only 30 years to reach the Oort cloud!

[Game Play]

Game Page: (https://gamejolt.com/games/breakthrough_omega/543623)

< Setting >
    (a) There are five planets on the map.
    (b) Each planet has one specific modern engine based on the planet characteristics, as illustrated below:
        i. Mars: Solar Sail
               Solar sails use sunlight as its source of propulsion energy, so the closer they are to the sun, the more suitable for them to be used. Therefore we build solar sail modules on Mars as the engine for traveling to the gas giants.
        ii. Jupiter: Mass Driver

               There are many moons around Jupiter, so we build a huge launch orbit on Europa taking advantage of the moons and Jupiter as gravity slingshots, to shoot the spacecraft away.

        iii. Saturn: MPD

               Titan is mostly made of ice and rock, but has a dense atmosphere and is located in Saturn's magnetosphere at 95 percent of the time, filled with charged

particles and plasma. Therefore we come to Titan to collect fuel for an ion engine.

    iv. Urans: NPP thuster

When coming to Uranus, where energy from the sun is marginally available and resources are limited, we must utilize nuclear energy as our driving force. Because generating nuclear energy produces a lot of heat waste, we also need to collect useful materials for cooling!

    v. Neptune: Bussard Ramjet

When coming to Neptune, ready for a try to leave the solar system, we need a sustainable source of energy. Fortunately with the Bussard ramjet, trace amounts of hydrogen and hydrogen ions in the interstellar space can be collected as the source of energy for nuclear fusion.

(c) Players need to accomplish all the missions on the planet. These missions can be divided into three categories: operation, mechanical assembly, and knowledge Q&A.

(d) Food and energy will be refueled once the new engine is received.

(e) Players can choose what type of engine to equip on the spaceship and a destination to travel to.

(f) The sufficiency of food and energy determines whether the player could successfully arrive at the destination.

(g) When all the five engines are collected, the player will win the "Warp Drive", which is the fastest engine we could scientifically think of. Finally, we take on the journey to our dream planet, Kepler-69c.

< Flow Chart >
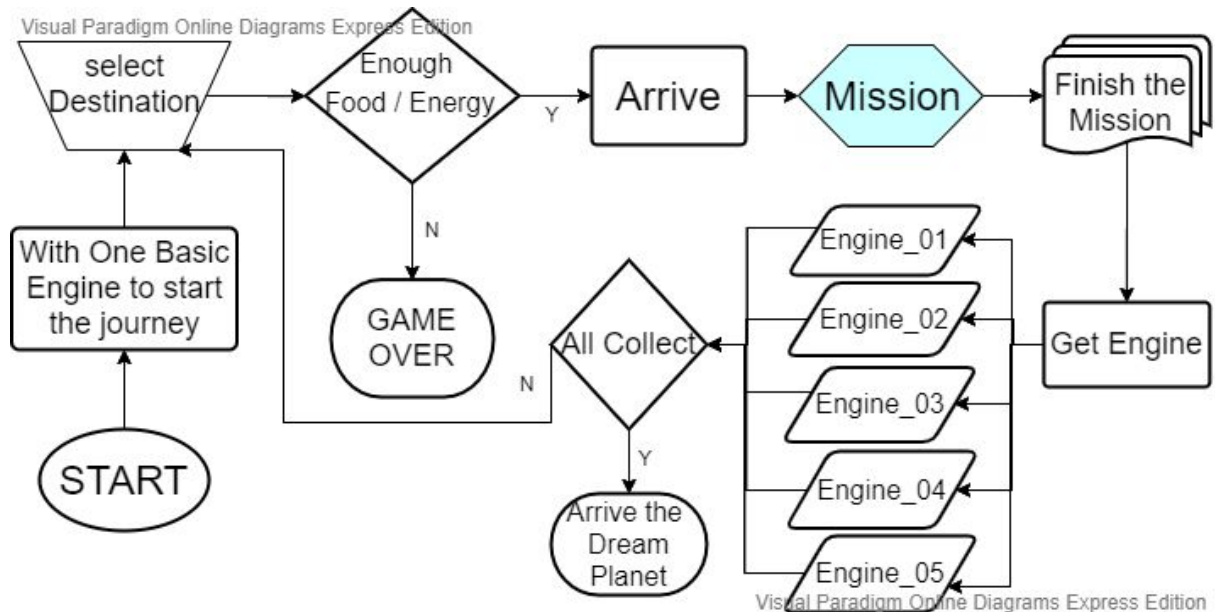
< Operation >

[Control Panel]

A - Dynamic calculate the remaining distance between the target planet.

B - Information about the target plant.

C - Current Engine Name

D - The real photo from NASA where the spaceship hasa pass by

E - Food and Energy will decrease by a calculated amount to limit the player reachable distance.

F - Target Planet Name

A. Knowledge

Solar sail,
Reflect the light from the sun or other sources by a huge film lenses,
And the light irradiating on the mirror surface passes through the reflection of photons to generate radiation pressure and to provide thrust.

Press Space To Contiune

Mass projector,
generally refers to device that accelerates objects by the force of an electromagnetic field.
In principle, Railgun and Coilgun.

Press Space To Contiune

Magnetoplasma thruster (MPD)
The principle of MPD is to ionized the gas first, then accelerate the charged ions with an electric field force, and then equip them to push the rocket with its reaction force.
These thrusters have a high ratio of thrust, which is the ratio of thrust to propellant consumption.

Press Space To Contiune

NPP thruster

A space thruster using nuclear explosions as thrust

Bussard ramjet,
a thruster with nuclear fusion as the core concept.

The warp drive has three key settings:
1. The space expended behind.
2. The space compressed in front.
3. The space-distorting bubble that surrounds the ship in the middle.

B. Control:

    a. Solar Sail:

       This game is designed to use the principle of solar sail movement to control the spacecraft to avoid collisions with asteroids.

       The operation method: move the bottom light source to make the solar sail move in the opposite direction. If the number of collisions within time passes the level not more than 3 times.
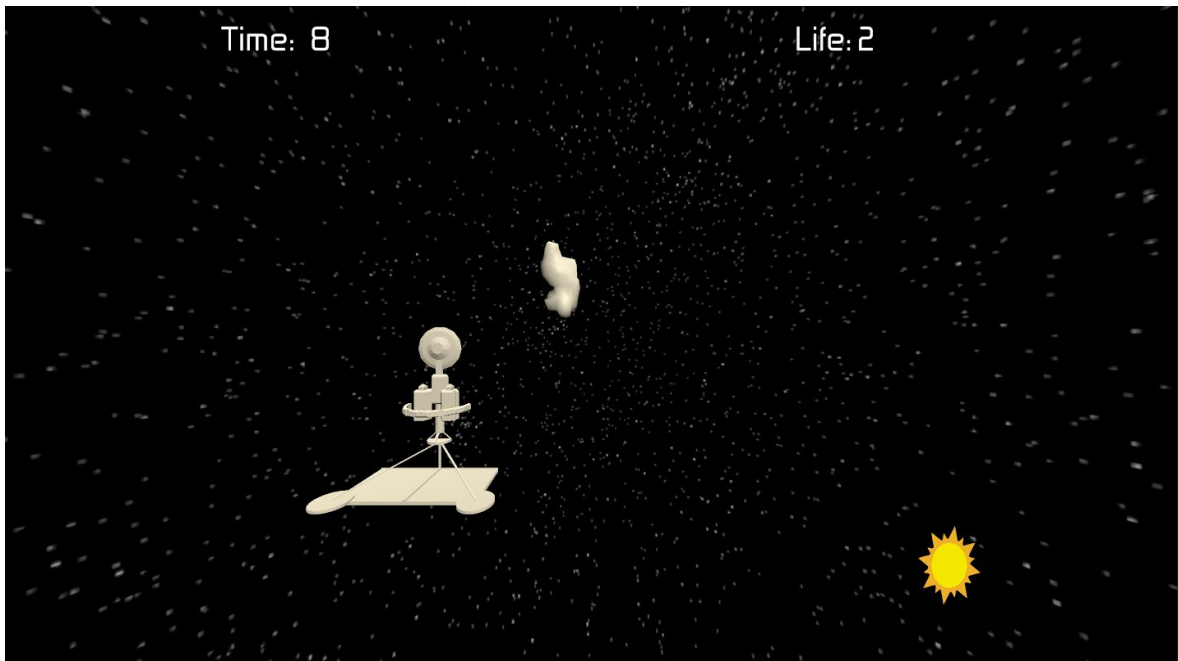
    b. Mass Driver

       Using the mass projector to reach the target! The spacecraft launched by the mass launcher cannot turn. When traveling in space, the 'gravity slingshot' will be used to accelerate the turn of the spacecraft. In the game, you will get one. The rotatable fixed turret can determine the launch angle and launch energy by itself, and pass through the gravitational field between the planets to reach the designated destination!

c. MPD

Controlled by the mouse, emit ions in different directions to dodge obstacles floating in the universe and head to the target

The operation method: Click on the position where exactly you want to emit the ions.

d. NPP thuster

Collect Uranium - 235 and Plutonium - 239 to produce the atomic bomb or collect deuterium, tritium and lithium hydride to produce the hydrogen bomb by parkour. You can detonate the atomic bomb and hydrogen bomb to speed up in order to reach the finish line in time.

The operation method: [W]Forward/ [A]Left/ [R]Right/ [S] Backward/ [Space] Jump and mouse for the viewing

e. Bussard Ramjet
    i.   Jump around to collect Tritium, deuterium ,and hydrogen ions for the next level.
    ii. Use hydrogen and hydrogen ions as bullets to shoot the moons for scoring
   The operation method: Move the mouse to aim and Press Space To shoot.

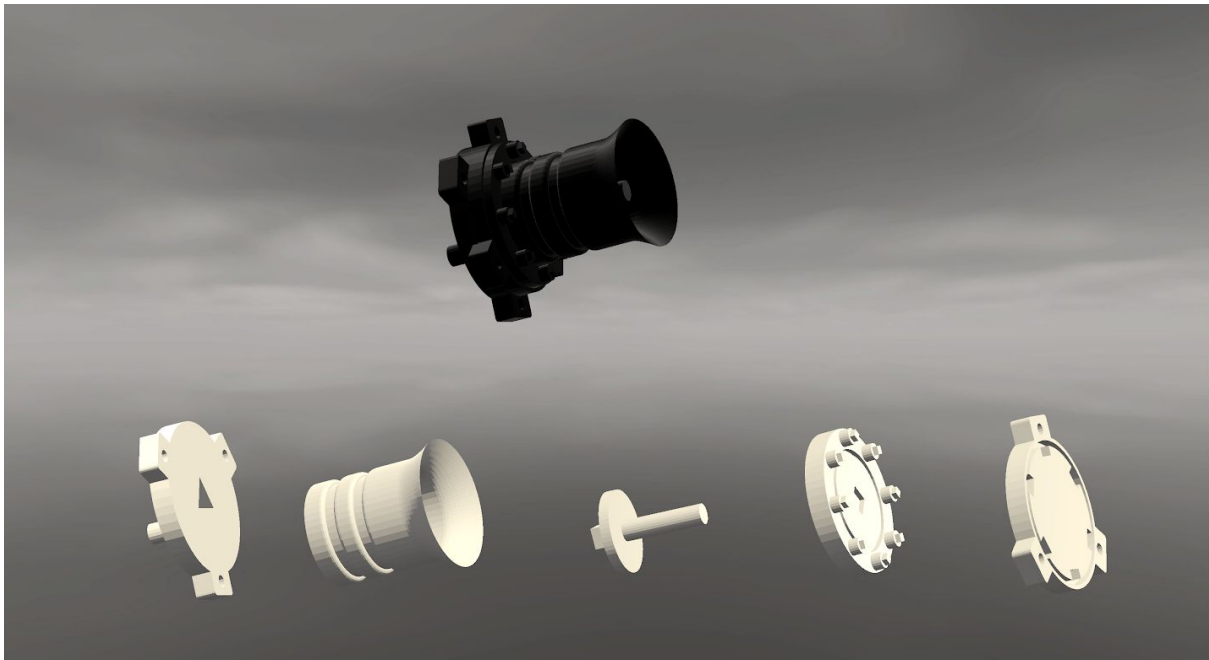f. Warp Drive
   A maze, designed with the concept of space wrap

C. Mechinal Assembly

Use the mouse to move the part to the position. Through the outline prompt, let the player understand the general structure of the thruster. After the assembly is completed, you will get the three-view drawing of the current engine and pass the level.
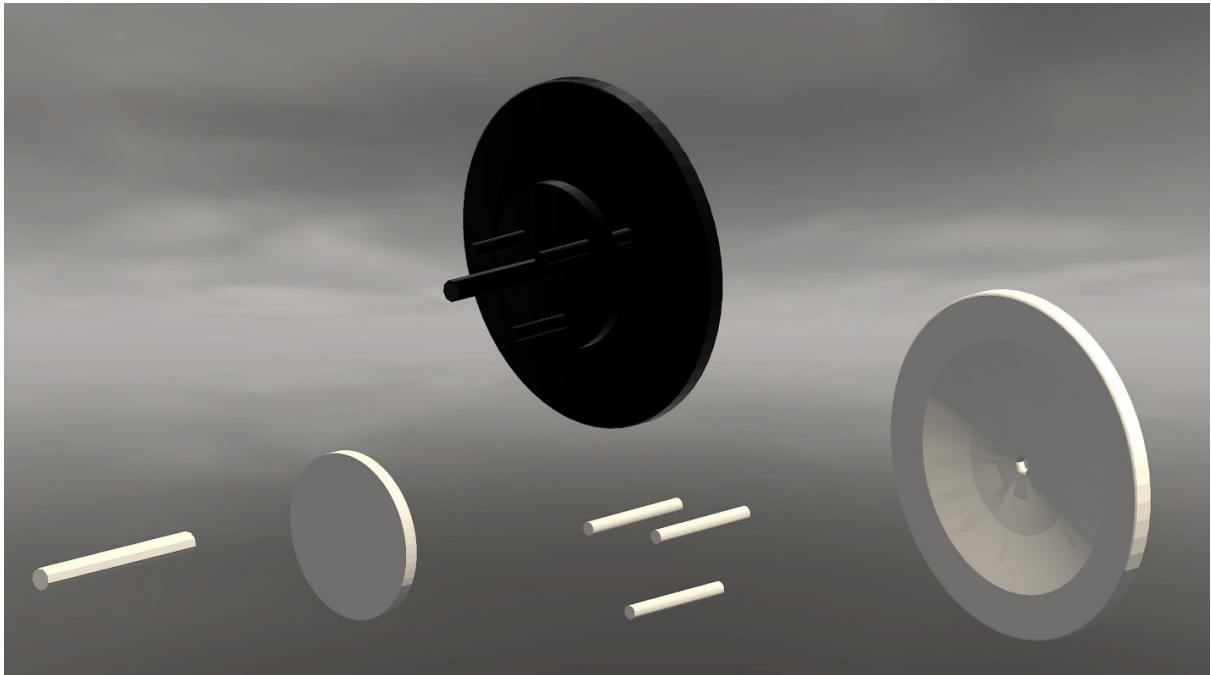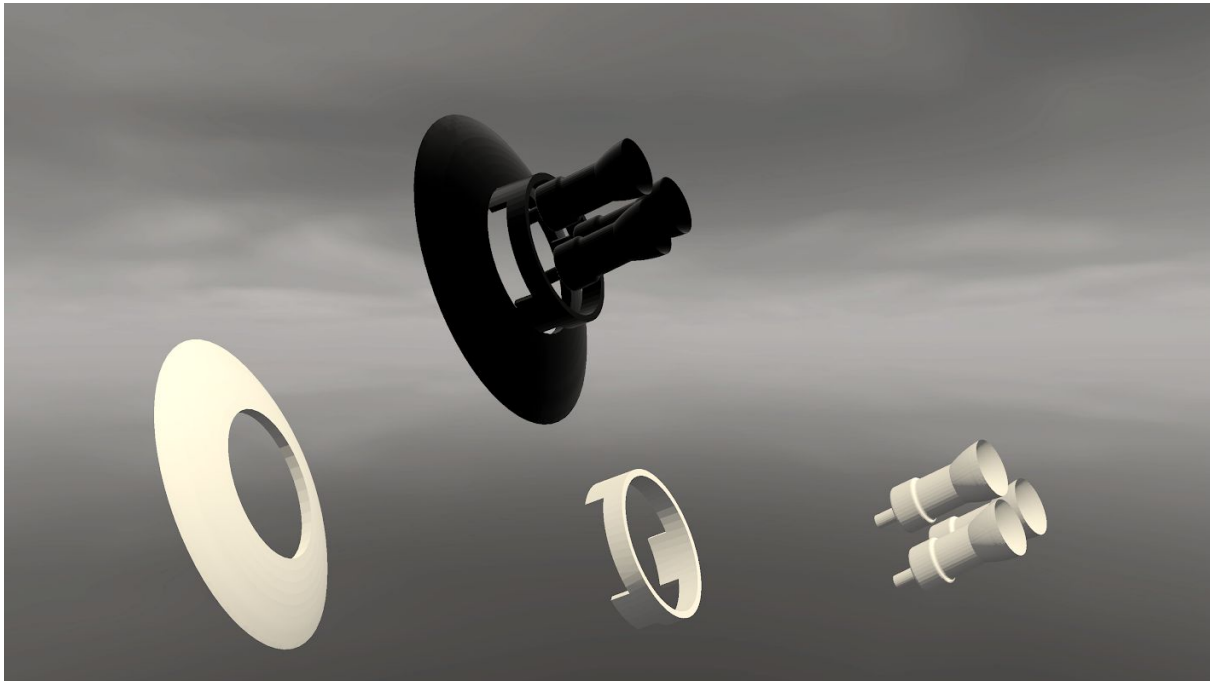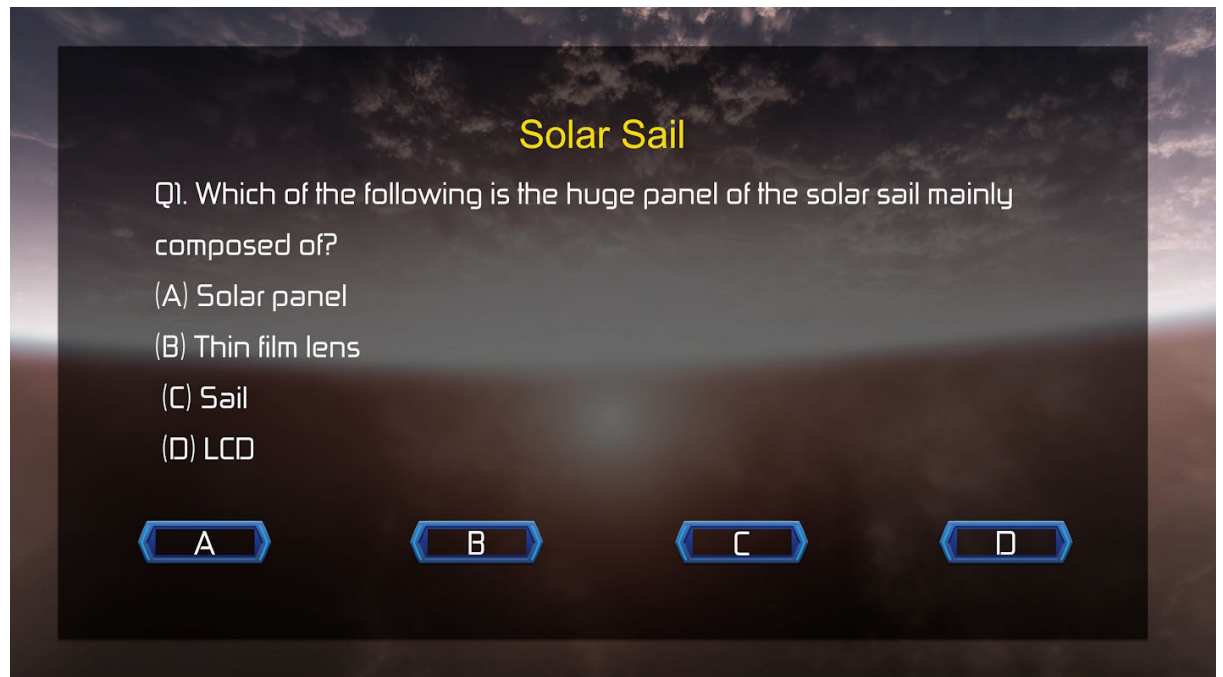
(a) solarSail
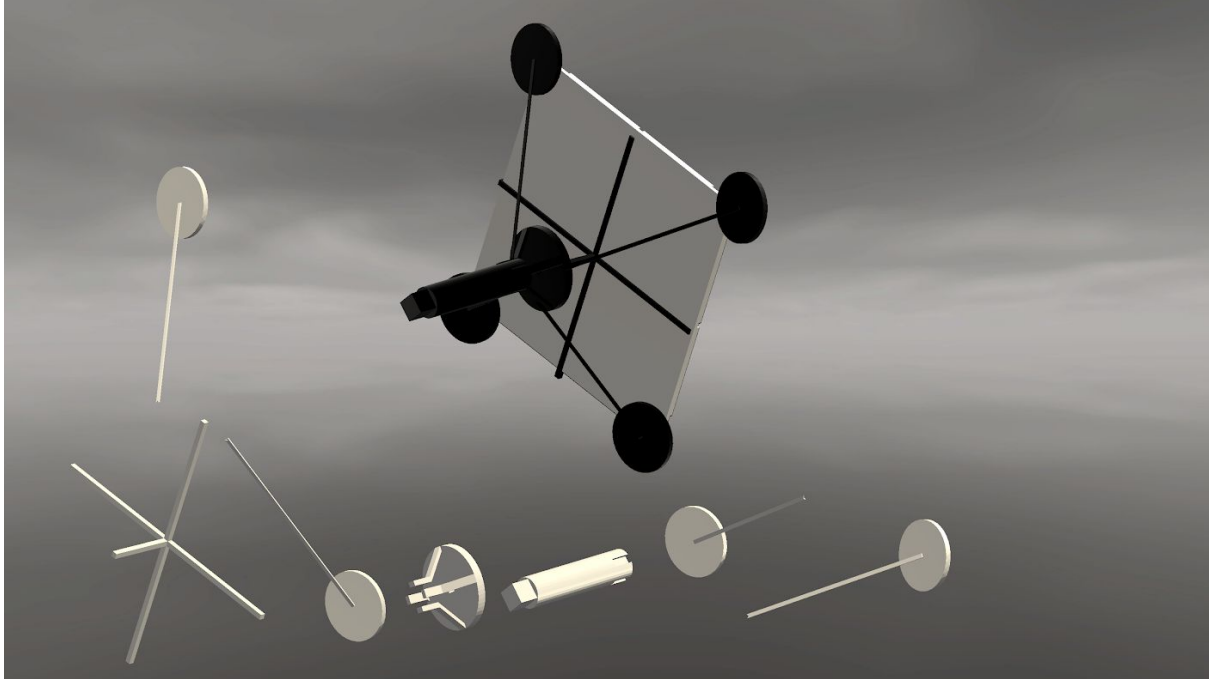
(b) MPD

(c) NPP thuster

(d) Bussard Ramjet

D. Q & A

[Develop Platform]

Unity3D : game developing with C#.
Autodesk Inventor : Draw 3D Model of engine for our game.

[Hard Issue]

Display in diversely various screen sizes.
Loading time of the game.

How did you use space agency data in your project?*

[Graphic]

We embed and utilize the NASA photos of solar planets in our game for simulating interplanetary traveling. We also use the knowledge about propulsion technology provided at various NASA websites.

Demonstrate your solution*

<Project Demo>

30Sec Video: https://youtu.be/-NiU_E6Mepw

Game Page: https://gamejolt.com/games/breakthrough_omega/543623

Share your code (if applicable)

<Project Code>

https://github.com/Chenade/Omega

<WebGL format>

https://github.com/Chenade/Omega_webGL

References: List the data and resources used in your project*

<Data & Resources>

[NASA]

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- https://photojournal.jpl.nasa.gov/
- https://pds-imaging.jpl.nasa.gov/
- https://pds-imaging.jpl.nasa.gov/
- https://www.jpl.nasa.gov/
- https://ntrs.nasa.gov/citations/20140000851
- https://www.nasa.gov/multimedia/imagegallery/index.html
- https://eyes.nasa.gov/

[Unity Assets Store]

- https://assetstore.unity.com/packages/2d/gui/techno-blue-gui-skin-19115
- https://assetstore.unity.com/packages/2d/textures-materials/sky/allsky-free-10-sky-skybox-set-146014
- https://assetstore.unity.com/packages/3d/environments/sci-fi/vast-outer-space-38913