

CS 148 Final Project

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Inspiration

Our inspo board: <https://www.pinterest.com/ethanyanjiali/cs148-project-ideas/>



Inspired by movie [Apollo 13](#), we would like to focus on the main character [Gene Kranz](#). Gene is an American aerospace engineer, flight pilot, and NASA flight director. He served as the second Chief Flight Director, directing the first lunar lander mission Apollo 11. He is especially famous for directing the Mission Control team by saving the crew of Apollo 13 after a routine stir of oxygen tank ignited damaged wire insulation inside it, causing an explosion that vented the contents of both oxygen tanks to the space.

The left image above is Gene's office scene which is also the basic setup of our project. The Apollo 11 wall photo clearly states the theme of space exploration. To further emphasize the theme, we added more wall photos including Apollo 13 configuration map, Apollo mission patches, Mr Kranz's diploma. We also placed a Saturn V rocket ship and a lunar lander model on his office desk. Gene had a famous saying when working his team to bring the crew back home safely called "Failure is not an option". Therefore, we added a newspaper about the dangerous situation of the Apollo 13 mission in comparison to Gene's "Failure is not an option" book to emphasize the danger of space mission and human's determination to explore space and bring their astronauts home safely.

However, unlike the left image of Gene's office with complete indoor lighting, we would like to combine both indoor lighting with outdoor lighting as well. This is inspired by an indoor photographer [John Stoffer](#) with his [photo](#) on the right above.

In summary, we combined the space exploration theme inspired by the Apollo 13 movie as well as Gene's office setting and the lighting from John Stroffer's image to come up with our final project.

Final Images

Main Image

3840x2160 16384spp



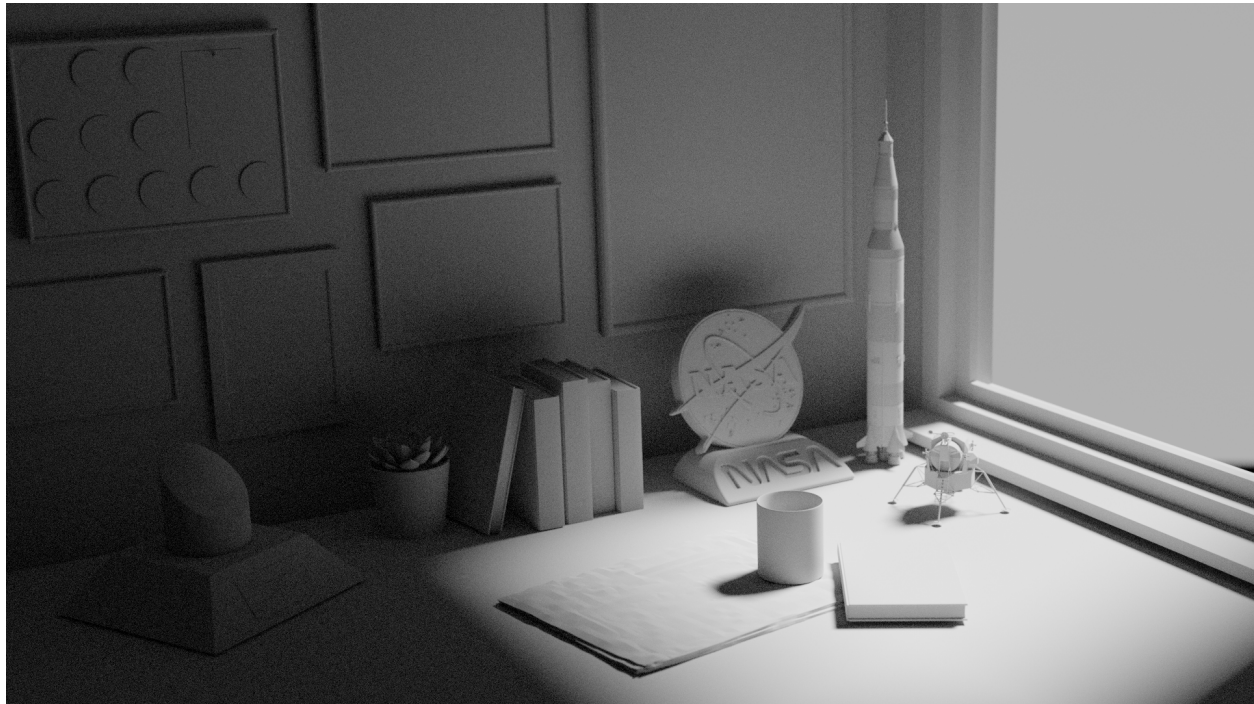
Variant A

1920x1080 different camera view



Variant B

1920x1080 gray, pure diffuse BRDF (the glass window and the volumetric scattering cube are removed)



Requirements

- ✓ **Main Geometry from scratch**
 - Most of the objects in the scene are made from scratch, such as the [Whiskey Glass](#), [Frames](#), Exploration Award etc.
 - To make wrinkles on the newspaper, we used cloth simulation as described in the [Newspaper](#) section.
- ✓ **UV Mapping and Texturing from scratch**
 - We satisfied this requirement when making book textures from scratch with an editing tool, and adjusted UV map as described in the [Books](#) section.
 - We also made custom UV mapping when wrapping a newspaper image, applying background image, etc.
- ✓ **Create a custom/procedural material**
 - We demonstrated a procedural material for chromatic dispersion and described the steps in the [Ambassador of Exploration Award](#) section.
 - We also utilized displacement map and normal map for the texturing of some photo frames, room wall and the desk.
 - We also used a noise texture with a bump vector to make the rough surface of the papers inside the photo frame.
 - We also added a volumetric scattering space in the scene to simulate floating dust
- ✓ **Blender/Cycles feature**

- To blur the background image outside the window, we also turned on Depth-of-Field feature. More details in [Depth-of-Field for Background Blurring](#).
- After rendering, we also used Blender compositing nodes for some post-processing such as denoising and gamma adjustment.

Work Breakdown

Yanjia Li

Yanjia is responsible for building most of the geometries, shader nodes and textures from scratch, including the newspaper, whiskey glass, photo frames, books, bulletin board and the crystal exploration award. He also worked on the background image outside, window shader, surface imperfection, and led the writing of the project final write up.

Lingjie Kong

Lingjie is responsible for finding the theme and importing high-quality assets from the internet, including the Saturn rocket ship, moon lander, desk, succulent plant, window frame and NASA logo sculpture. He also made Apollo badges, and led the writing of the project proposal.

Both

We worked together to source and debate ideas, arrange lighting and scene layout, make reflective window glass, and also endless re-rendering.

Assets By Ourselves

Books



Geometry downloaded from [TurboSquid](#)

Textures made by Yanjia Li

We reuse the same geometry for all six books but adjusted the dimensions to create some variation. The textures are edited with some photo editing tools and also photos either shot by ourselves or downloaded online. And then we did some extra UV editing to make the book cover align with the geometry.

Newspaper

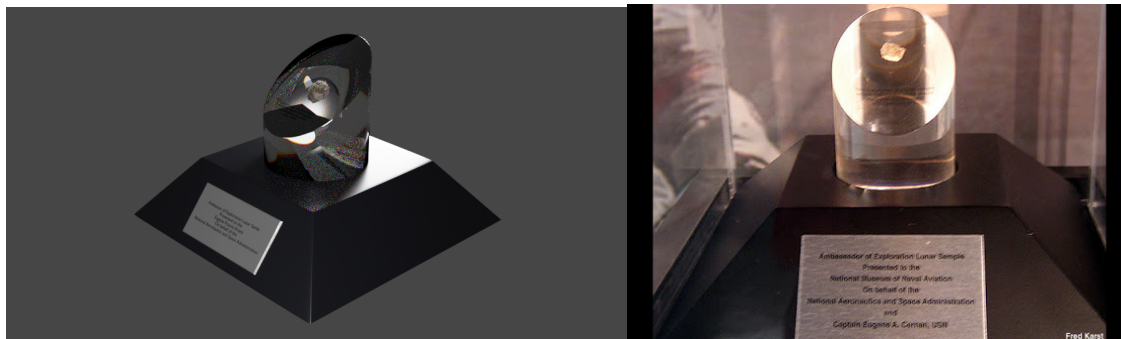


Geometry made by Yanjia Li

Textures downloaded from [NY Times](#)

We want to make some wrinkles on our newspaper so that it looks more natural. In order to do so, we first folded the solidified plane in half, and then used Blender cloth simulation and let the paper fall down on a ground plane. By setting the subdivision, weight, and other physical parameters properly, we are able to get a good enough newspaper. Then we stack two newspapers together. The texture is the headline from April 14 1970 downloaded from NY Times archive website which matches our theme of the Apollo 13 event.

Ambassador of Exploration Award



Geometry made by Yanjia Li

Crystal and base texture made by Yanjia Li, moon rock texture downloaded from [Texture Haven](#)

Since Eugene Kranz received this award for his accomplishments, we want to [replicate this award](#) as well. Inside the crystal there's a little piece of moon rock, we made it with the same technique learned from HW8 using a displacement map. Inspired by a Stackoverflow post, the crystal with dispersion effect is simulated by combining three different colors of glass shaders with different IOR. We also added some sentences on both the metal plate and the crystal using Blender 3D text.

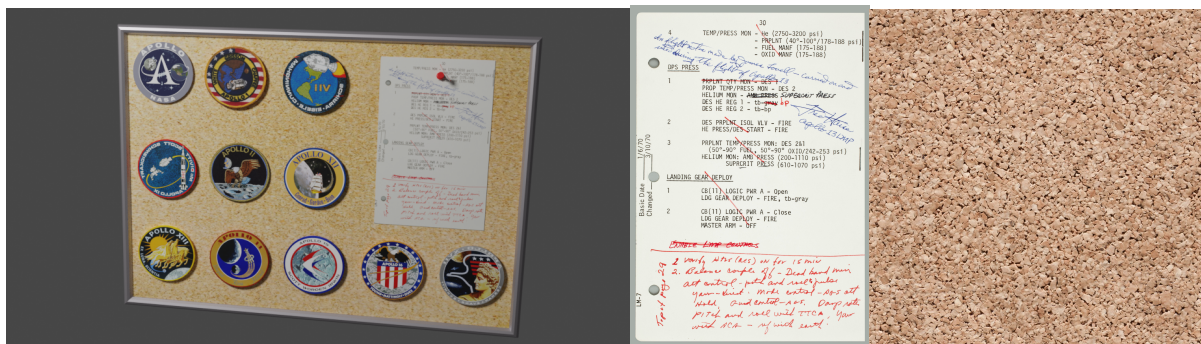
Whiskey Glass



Geometry and texture made by Yanjia Li

We got inspiration from this [Youtube tutorial](#) and made our own whiskey glass to show the power of ray tracing. The glass and liquid are made from a cylinder with some techniques like solidify modifier, subdivision, loop cut and inset. Although not noticeable in the final image, we also simulated surface tension by adjusting the geometry around the edge of the liquid. The ice cubes are made from beveled cubes. The texture is principal BSDF with transparency adjusted. To make the cloudy feeling of the whiskey liquid, we also turned on volume absorption and tweaked the density.

Bulletin Board



Badges geometry made by Lingjie Kong

Board frame and note geometry made by Yanjia Li

Board pin geometry downloaded from [TurboSquid](#)

Board texture downloaded from [3DTextures](#)

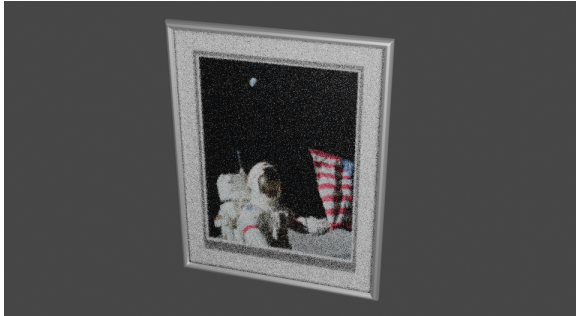
Note texture downloaded from [Abemlem](#)

High resolution badges texture downloaded from [Wikimedia Commons](#)

Unlike other frames, we don't have a glass for bulletin boards. Instead we applied a cork board normal map and displacement map to make a rough surface. We also made badges from cylinders and adjusted their materials to show different textures and reflections.

Frames

Most of the frames on the wall are made in the same procedure: First, we create the frame itself from a 4 segments Torus mesh. Next, we carve out a groove with scaled extrusion. Finally, we add a piece of glass in front, a piece of board at back, and also pictures and some accessories in between. Although the geometry is made in the same fashion, we made some custom shading with a normal map, and changed the material parameters to give them a different look.



Gene Cernan on the Moon

Geometry made by Yanjia Li

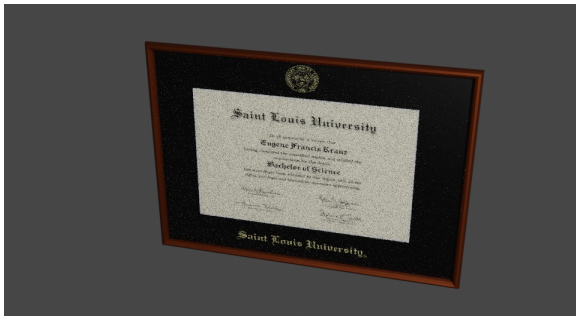
Texture downloaded from [NASA](https://www.nasa.gov/)



Apollo 13 Flown American Flag

Geometry made by Yanjia Li

Texture downloaded from [Heritage Auctions](https://www.heritageauctions.com/) and [Texture Haven](https://www.texturehaven.com/)



Eugene Kranz's Bachelor Degree

Geometry made by Yanjia Li

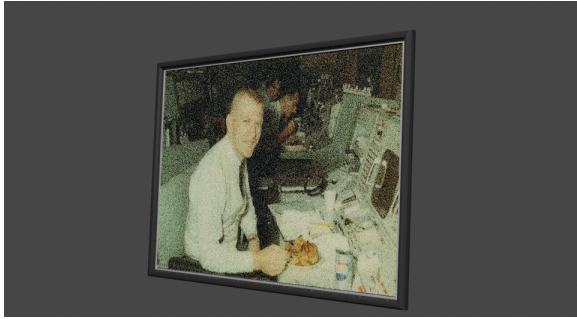
Texture edited by Yanjia Li with image from [Diploma Frame](https://www.diplomaframe.com/) and font from [Fontsquirrel](https://www.fontsquirrel.com/) to match Eugene's name and degree



Apollo 13 Configuration

Geometry made by Yanjia Li

Texture downloaded from [Anatomynote](https://www.anatomynote.com/)



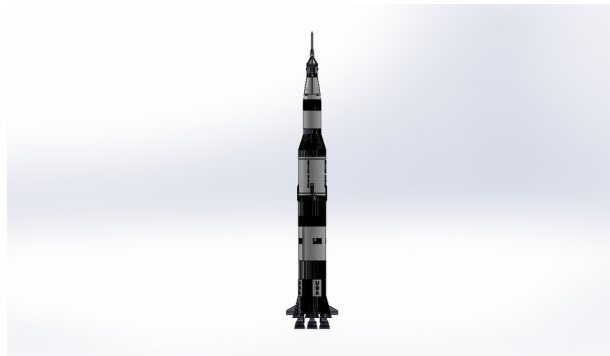
Gene Kranz Portrait

Geometry made by Yanjia Li

Texture downloaded from [Digitaltrend](#)

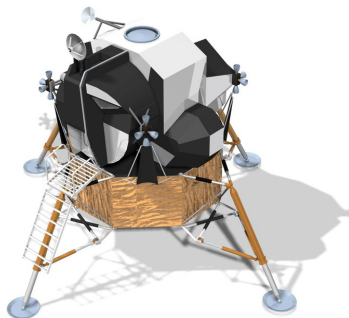
Assets From Internet

Saturn V Rocket



The Saturn V Rocket is downloaded from [Grabcad](#) and post-processed by Lingjie Kong. The original format is SolidWorks assembly .SLDASM, we imported it into AutoDesk Inventor because it is student free, saved it as obj to preserve texture and eventually imported it into Blender. We then modified its materials property to make it more metallic.

Lunar Lander Module



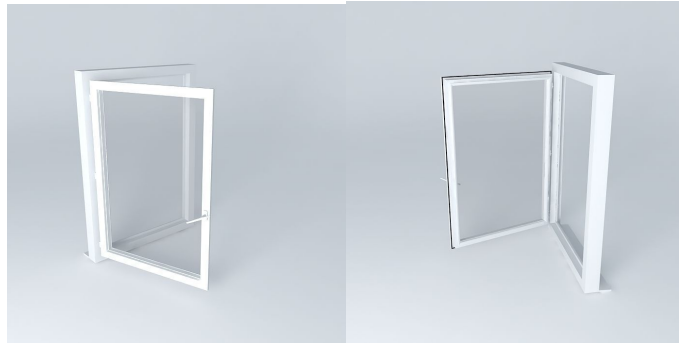
The Lunar Lander Module is also downloaded from [Grabcad](#) and post-processed by Lingjie Kong. By following the same procedure as above, we imported it into AutoDesk Inventor, saved it as obj to preserve texture and eventually imported it into Blender for rendering.

NASA Logo



The NASA logo is downloaded from [Grabcad](#) and post-processed by Lingjie Kong. Similarly, the original format is SolidWorks assembly .SLDASM, we imported it into AutoDesk Inventor, saved it as obj, and imported it into Blender for rendering.

Window



The window geometry is downloaded from [CGTrader](#), window frame texture is downloaded from [BlenderKit](#), window glass fingerprint texture is downloaded from [3DTextures](#) and post-processed by Yanjia Li. We also added some custom shader to create a realistic feeling, more details in [Custom Shading for a Realistic Window](#).

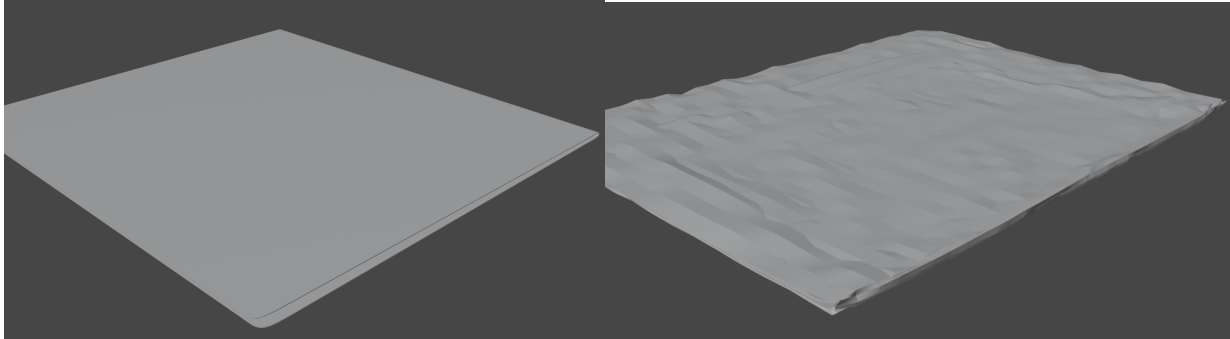
Succulent Plant



Geometry and texture downloaded from [Polligon](#), imported by Lingjie Kong

Technical Contributions

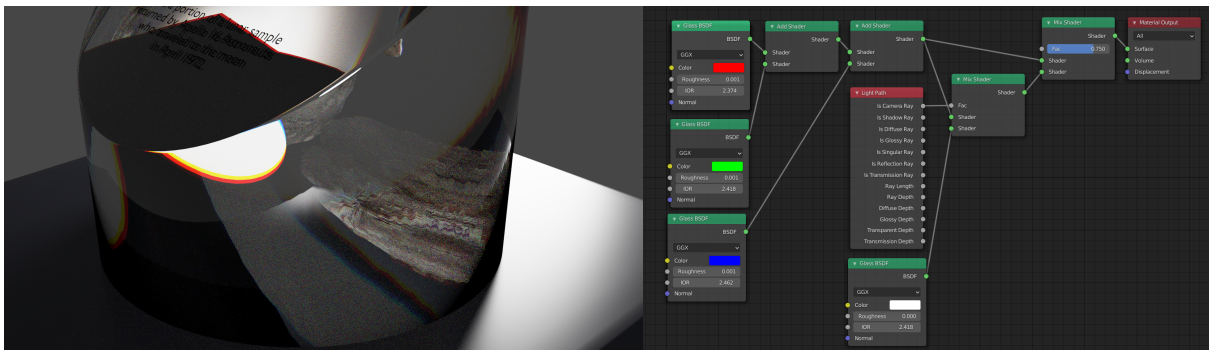
Cloth Simulation for Newspaper



In order to make a natural feeling of the newspaper's uneven surface, we ran the cloth simulation on a folded newspaper. We decided to go with simulation instead of using normal map and displacement map because the creases on the paper usually have some consistency, i.e. the changes in geometry usually affects nearby areas along the fiber direction. To make a successful simulation, we added more subdivisions, and turned on cloth physics for the solidified newspaper plane. Next, we need to update the vertex mass to be a small number, lower the collision distance, and also tweak the stiffness and damping. Otherwise the paper will bounce with each other and shrink into a crumpled paper ball. Finally, we added a cube below as a ground surface, and turned on collision physics for it. We chose the best frame during simulation and applied the final physics modifier for the geometry.

Aside from the crumpling ball effect, we also ran into some other challenges during the simulation. For example, the subdivision affects the granularity a lot, but too much granularity for the creases will also give the newspaper an unreal feeling. Also, since we are dropping a folded newspaper onto the ground, part of the bottom layer would sometimes go above the upper layer during simulation, so we need to turn on self collision, and set the collision distance properly.

Custom Shading for Dispersion



Since the material used by the Exploration Award is very precious, we want to have it to reflect more colors like a diamond did. Diamond has an IOR around 2.4, but setting this parameter is not enough to have a realistic view. What we want to simulate is the ability to bend different wavelengths of light, so that we can not only see the white shines but also colorful ones.

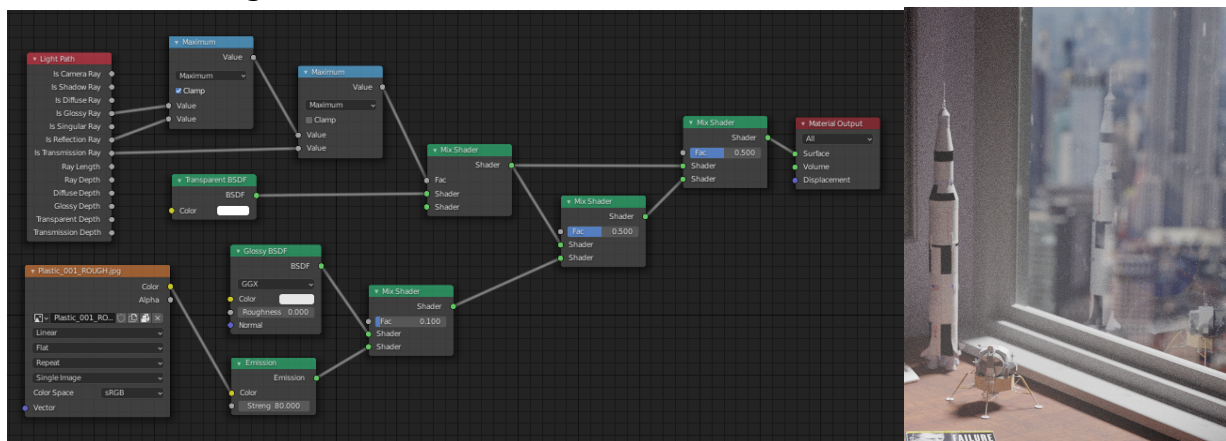
Motivated by this [post](#), we set IOR to be slightly different for RGB colors, and then combine them together. To mediate strong dispersion effect, we also mix in a regular white shader node. This effectively gives us a chromatic aberration effect discussed in the lecture.

Depth-of-Field for Background Blurring



Setting up a good background is not an easy task, let alone balancing lighting and complexity between the background and foreground objects. To solve this issue, we enabled Depth-of-field feature of the blender camera, and blurred the background image to bring the focus back to the indoor scene. After some experiments, we decided to use f/2.8 and 6 blades for the aperture, which gives us the most natural feeling of the background.

Custom Shading for a Realistic Window



The built-in Principled shader and Glass shader is caustic and won't let light pass through. This is a big trouble for us because all our lighting comes through the window. In addition, we also want a reflection effect on the window to simulate the strong light environment. To address this, we came up with a custom shader to combine Transparent BSDF with Glossy BSDF using a Light Path node. Furthermore, the window under sunlight usually shows some marks in reality, so we also added an Emission shader to highlight the fingerprint texture to demonstrate surface imperfection. Likewise, we added a normal map to the window frame for the dents and scratches.