A Hypothesis-Driven Approach to CGI Filmmaking: The Making of "Multiplanetary Life"

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Multimedia and Creative Technology

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APPROVAL

This Project titled **Story Hypothesis visualizing through 3d Animation, Narration, Composition for animated short film "Multiplanetary Life"**, submitted by MD. Adnan Parvez (ID: 191-40-573) to the Department of Multimedia and Creative Technology, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Multimedia and Creative Technology and approved as to its style and contents. The presentation has been held on February, 2023

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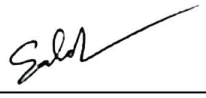

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DECLARATION

I hereby declare that; this project has been done by me under the supervision of **Mr. Arif Ahmed**, Associate Professor, Department of MCT

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Finally, I must acknowledge with due respect the constant support and patients of my parents and other family members.

ABSTRACT

Multiplanetary Life is an animated short film based on scientific hypothesis, The film is led by a narration which was narrated by American astronomer, planetary scientist, cosmologist, astrophysicist, astrobiologist, author, and science communicator CARL SEGAN. Throughout the whole film, A collection of many scenes can be seen, that represents many forms. Timelines and situation of human life. Such as, it shows how human species came from cave to today's world in a cinematic way. It also shows human evolution that could be done in near future which are possible if we go ahead with a certain inspiration, effort and encouragement. Such as human being multiplanetary life and living in Mars, Human harvesting energy from the sun using Dyson sphere thesis or may be human travelling in lightyear speed.

A hypothesis states predictions about what research will find. It is a tentative answer to research questions that has not yet been tested. The purpose of this film is exactly the same. It represents visuals that may be occurred in future based on actual scientific research. It will be helpful and heartwarming content for people who are interested in space, human evolution and futuristic consequences. It also shows the actual visuals that scientifically correct but has not been seen yet.

The making of the film took around five months to complete. All stages of production have been thoroughly supervised, including pre-production, production, and postproduction. It highlights several significant aspects of the project's development, including conducting research on a different planet, managing a large number of polygons, optimizing 3D environment scenes, maintaining a seamless look, using unusual camera angles and a camera rig, utilizing cloud rendering, creating a unique sound design, maximizing monitor resolution, managing the entire project with free tools, and Personal production pipeline creation that can be very much helpful for individual artists.

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CHAPTER 1

INTRODUCTION

1.1 Background

A research hypothesis is a statement of expectation or prediction that will be tested by researches. Which we always see in movies and documentaries. A Hypothesis can be just a prediction but most of the time, because of vast numbers of researches, it can occur as a reality. We have been experiencing this for a very long time. As an example, in the movie "2001; A space odyssey", director Stanley kubrik showed people in space. People travelling through different planets and living in space ship. This was in 1968. And one year later man landed on the moon for real. Many elements that are showed in many science fiction movies are happening in real life right now. And even we take something outside science fiction, in the movie "Contagion (2011)" we see a huge pandemic that happens and how people go through that, this happened exactly in a same way by the corona pandemic. Hypothesis is not just a thesis because there are a lot of researches get involved in that. And the predictions from that are not just fantasy.

Multiplanetary Life is something like that, based on hypothesis that have been continuously researched in NASA, Space X, and other planetary research organizations, this film represents human evolution, the exploring system built into us by natural process that doesn't allow us to stay in one place and how it can take us to other planets. This film was inspired by many books by many scientists, especially the book called "Pale Blue Dot" by Carl Segan. In face a narrative was used in the film to give the vibe of seriousness of these hypotheses. The narrator is Carl Segan himself. Some portion of the audio version of the book was taken, and some audios from his many interviews was mixed together.

1.2 Motivation

Motivation for this film was literally every single CG work that involved hypothesis in some way. There are a lot of movies, series and documentaries where the power of beautiful concepts based on real life research were shown perfectly. If we talk about example, a film by Christopher Nolan can be brought in front. “Interstellar” is movie where the director hired scientist to do research so that the concepts and visuals represent the actual version of every element in the movie. Such as the black. In the movie they showed a black that was created using mathematical equation of physics and with the help of hypothesis that was done before that. At the end they made a beautiful visual of a black hole. But years after that, when scientist took the first photo of an actual black hole, they realized it looked almost the same as the one Christopher Nolan featured in his movie. This is why its so important to visualize imagination with a good amount of actual research and this prove the point of immense possibilities of the hypothesis on human evolution.

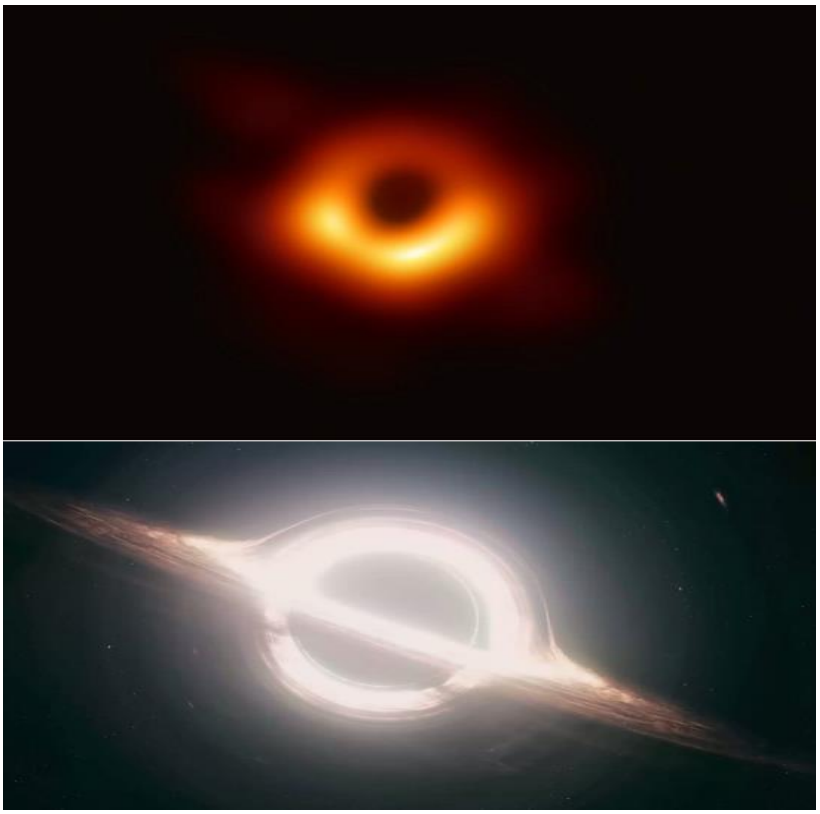


Figure 1.1: Real black hole and black hole from Interstellar

The very first sci-fi movie mankind ever created was called “A Trip to the Moon” by Georges Méliès in 1902 based on Jules Verne’s novels “From the Earth to the Moon and Round the Moon”. Years later human stepped on the moon’s surface.

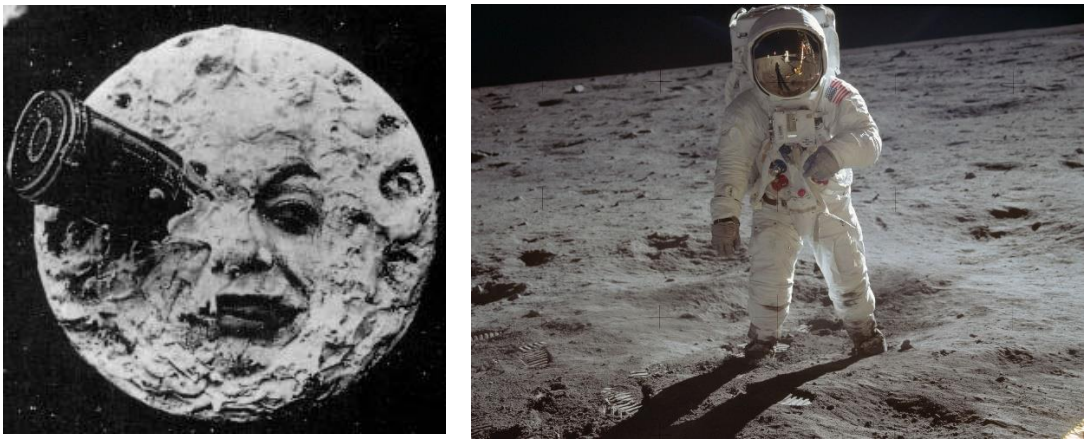


Figure 1.2: Goerges Melies moon landing and real moon landing

This Short film is mainly inspired by work of an individual artist named “Erik Wernquist” who have been working on visualizing thesis of NASA, Space-x and other scientist’s personal work / presentations. There was a documentary based on a book (1976) by American physicist Gerard K. O'Neill. He explained in his book about how human community can live in space inside a giant and massive cylinder. Erik wernquist made a beautiful narrative short film on this and on many other topics, that motivate me more on this hypothesis imagination world.

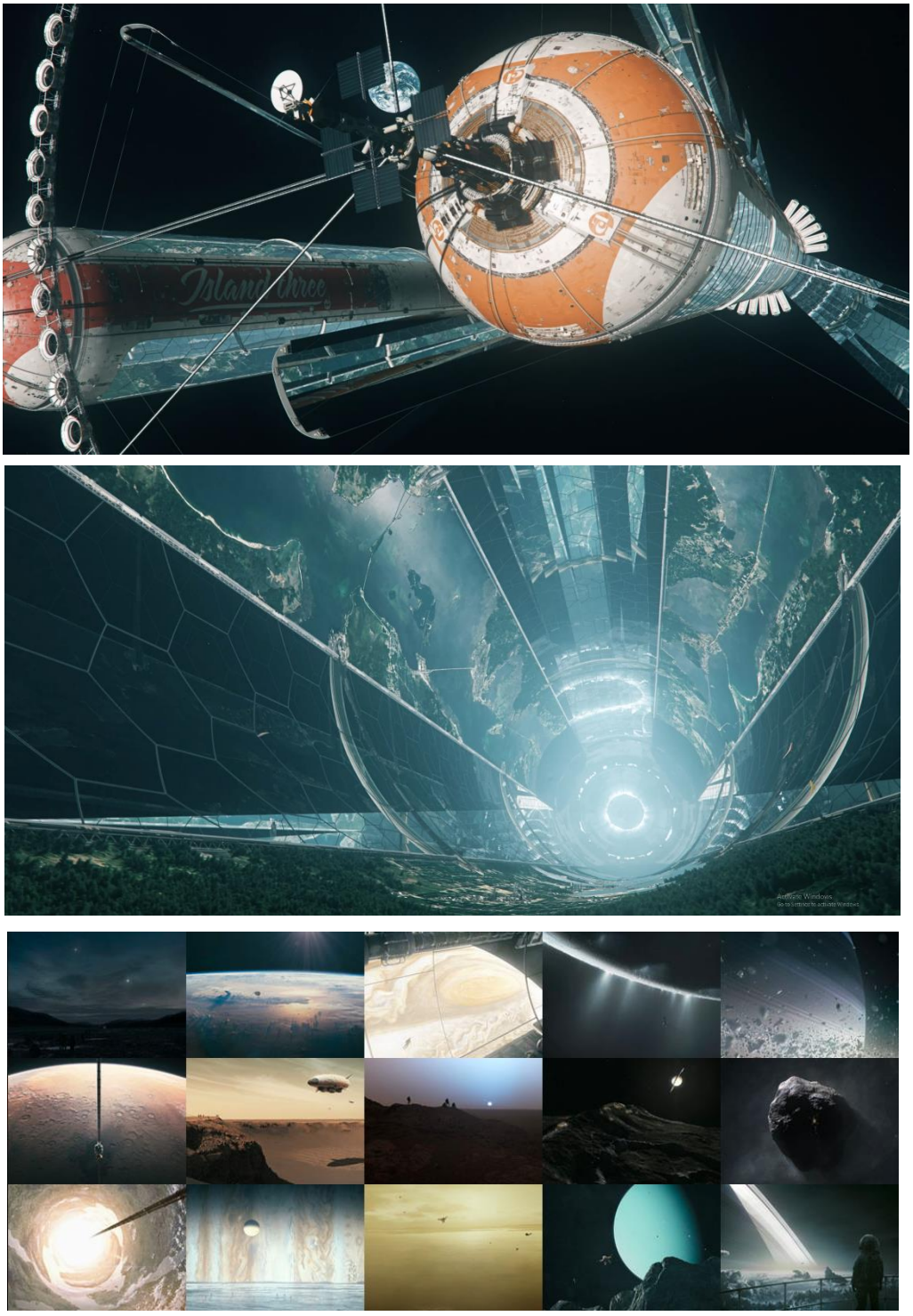


Figure 1.8: Erik Wernquist's Hypothesis short films

CHAPTER 2

NARRATED AND ANIMATED FILM

2.1 Narrated film history

Any movie that tells a fictional story set in a particular setting and period of time is considered a narrative film. It frequently progresses through conflict or a challenge the main character(s) faces. Similar to recounting a narrative to a buddy, but with considerably more depth and purpose, the events show on the screen in some form of succession. Usually, a narrative film carries a voice behind the visual to narrate everything in a poetic way.

Why do films use narrative? Here are some of the causes:

- to impart knowledge and to present a vision
- to show idea in a compelling way in order to make the film's message approachable
- People will always be able to understand and enjoy stories that are well-told and contain genuine settings and scenarios.
- to share a vision or idea in a captivating form
- sometimes it’s just better aesthetic to have a beautiful voice in films

It is widely believed that Porter's The Great Train Robbery (1903) was the first narrative movie to accomplish such action continuity. [1]

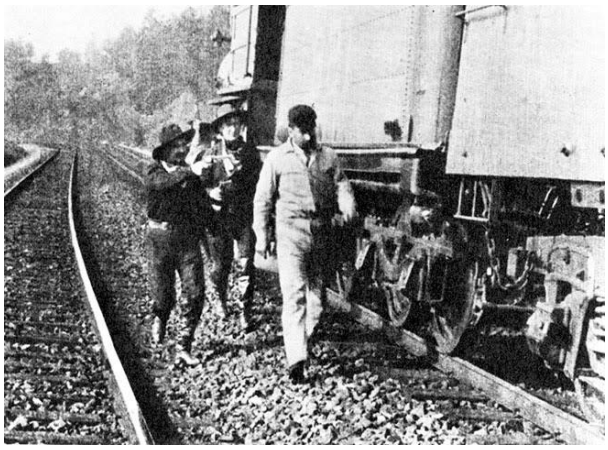


Figure 2.1: The great train robbery (1903)

2.2 Narrated and animated film ideas

Let's define animation in terms of how it relates to narrative. According to Pikkov and Näripea (2010) on page 15, the Latin word "anima" implies "the breath of life," "vital principle," or "soul." Animation is a presentation of still pictures that are put together and projected for the audiences, according to Ülo Pikkov in a study about Animasophy. He presented two contrasts between animation and live-action cinema and between animation and puppet show. Although all three of the aforementioned types have story, they are distinct from one another. Marionettes move in real life, whereas viewers of animation are shown movement that occurs not on the screen but rather in the viewers' minds. Despite the fact that a live-action film also includes a number of still images

One of the key components of animation is narrative, which sets animated films apart from other types of animation. The essential function of the "film" component of "animated film," which is to tell a story framework, is satisfied by narrative.

Some good narrated movie and documentaries: [3]

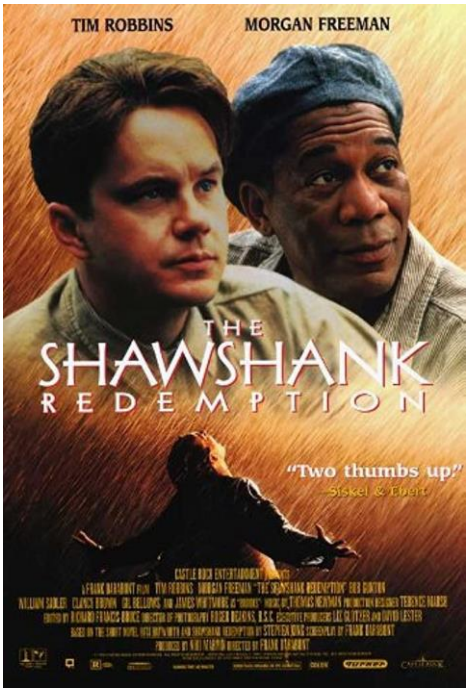


Figure 2.2: Shawshank Redemption (1994)

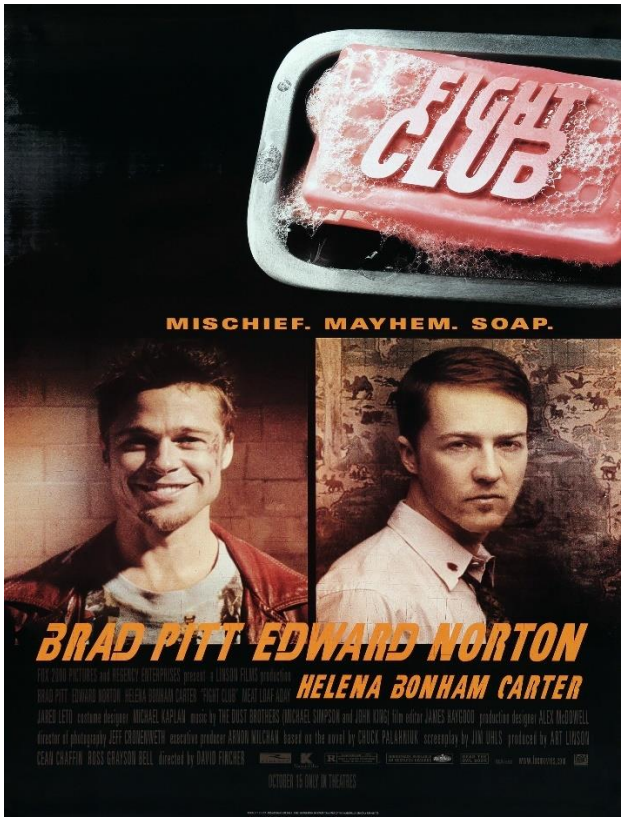


Figure 2.3: Fight Club (1999)

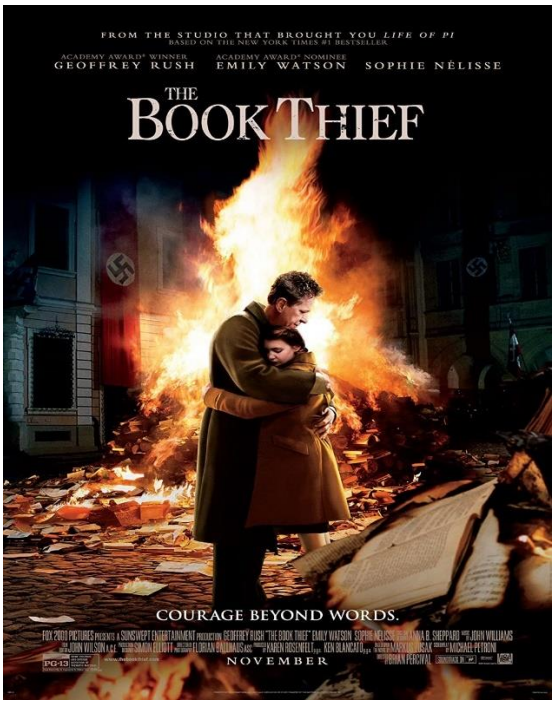


Figure 2.4: The Book Thief (2013)

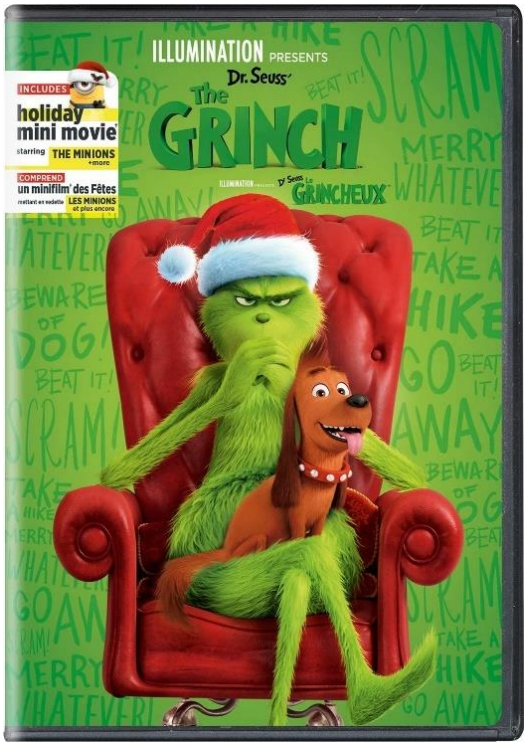


Figure 2.5: The Grinch (2018)

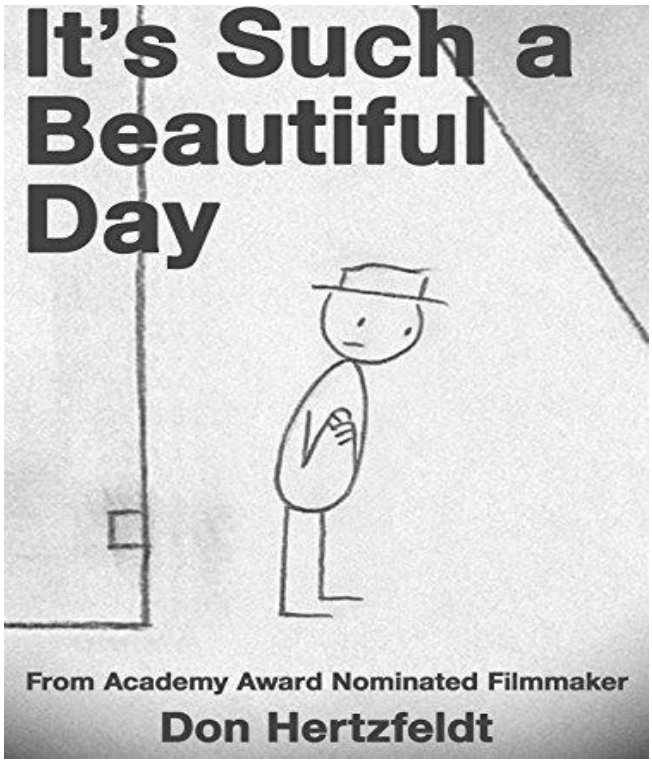


Figure 2.6: It's such a beautiful day (2012)

CHAPTER 3

CASE STUDY

3.1 Overview

A movie or documentary or series that has any kind of research or hypothesis in it, has to go through a bunch of reference, research papers or examination in order to get a perfect logical sense. My work on this short film is not outside of that area. Since there are a lot of references of hypothesis, I had to go through many books, papers, movies and other references that I could find. Science fiction books and films are full of futuristic concepts, but they typically use them to set up an exciting adventure rather than as a serious attempt to forecast future developments in science or technology. According to the rules of physics as we currently understand them, some of the most popular tropes—like accelerating a spacecraft to amazing speeds in a matter of seconds without crushing the occupants—are just not possible. However, the same laws seem to allow for other seemingly fantastical sci-fi ideas, such as wormholes and parallel universes. Science fiction is a well-known genre that amplifies elements of actual science to create fictitious works. As an illustration, after watching interstellar, Michio Kaku (American theoretical physicist, futurist, and popularizer of science) said: “Just saw Interstellar. Great movie. Highly recommended. They only broke a few laws of physics. (They even have some string equations.)”

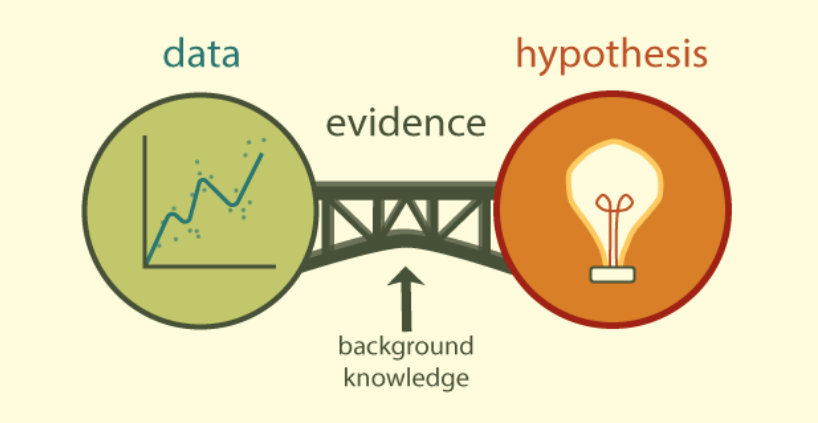


Figure 3.1: Hypothesis Structure

3.2 Review of Related Literature

Science fiction authors occasionally have the power to imagine the future. For instance, Mary Shelley investigated the concept of reanimating bodies before the defibrillator was created. Before the technology even existed, Jules Verne envisioned going into space.

When the Sleeper Wakes was published in 1910 by author H.G. Wells. He recalls how two men passed through what appeared to be a solid wall. The wall "rolled up with a snap" to allow entry as they got closer before closing once more. And then Automatic doors that opened on either side of an entranceway were created in 1954 by Dee Horton and Lew Hewitt.

A handheld communication device was envisioned in Star Trek. The device was referred to as a "communicator" and had the capacity to communicate over impossibly large distances, allowing Captain Kirk to get in touch with the Enterprise that is now in orbit while he is stranded kilometers below the surface of a planet. Martin Cooper, who was in charge of Motorola's communications systems group at the time, was motivated by it to create the mobile phone.

An interactive digital environment was first shown in the 1982 movie Tron. Neal Stephenson published Snow Crash, a book on virtual reality, in 1992. It is strikingly similar to modern virtual reality. Currently, parallel worlds can be experienced with googles, haptic gloves, and metaverse. Soon, perhaps even taste and smell will be a part of the total experience.

Isaac Asimov made predictions about the state of the world in 50 years in a piece he wrote for the New York Times in 1964. One of his many, uncannily correct forecasts was the creation of a car with a "robot-brain.". K.I.T.T. from the 1982 television series Knight Rider is among the most well-known instances. Even James Bond frequently droves vehicles with driverless features. Today we have fully automatic self-driven car such as Tesla. Numerous additional manufacturers and tech firms are vying to develop completely autonomous vehicles. [4]

These are some basic examples of how a hypothesis or prediction can come true in near future. All the advanced technology we are using right now were some kinds of theory back in times. So why won't we say that the predictions and theory experts, scientists are giving today will come true someday? This is exactly why, I have gone through a tone of books, papers and movies to get some idea about what might happen in our near future.

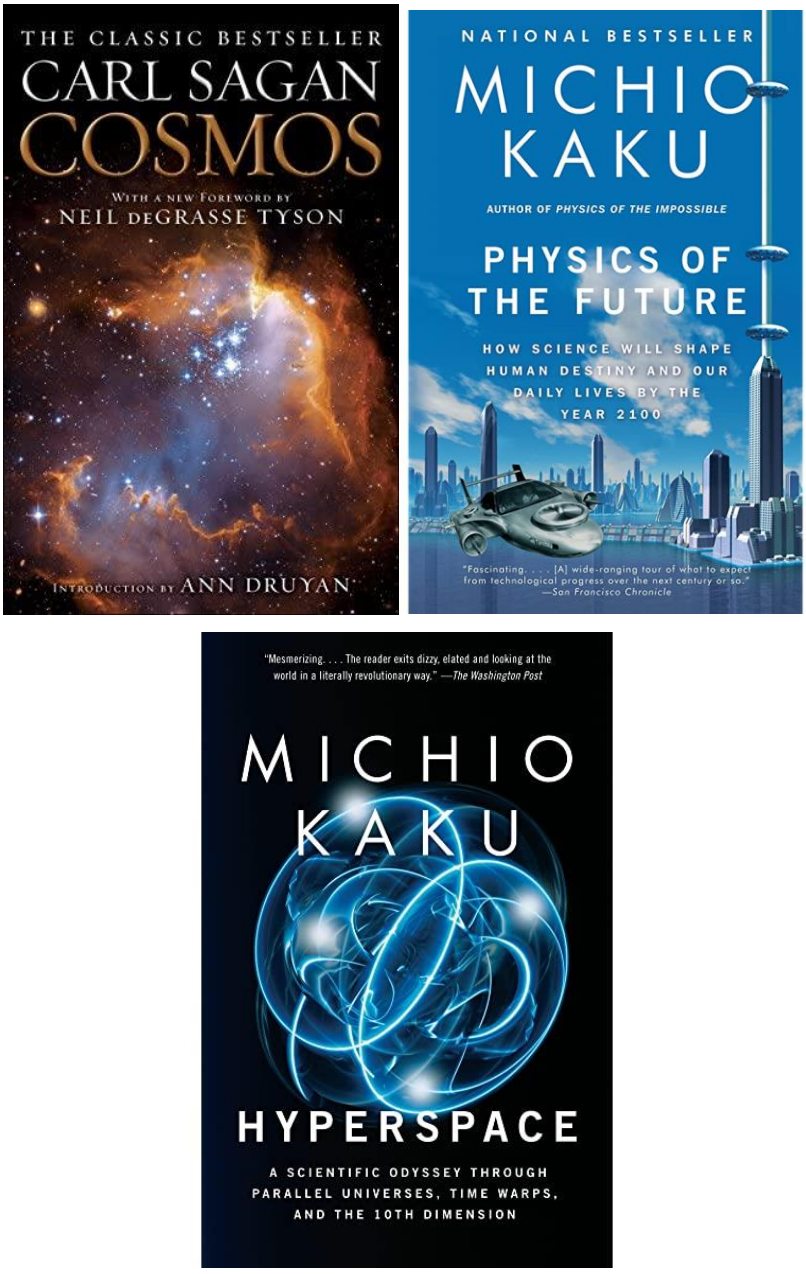


Figure 3.2: Michio Kaku and Carl Sagan's books

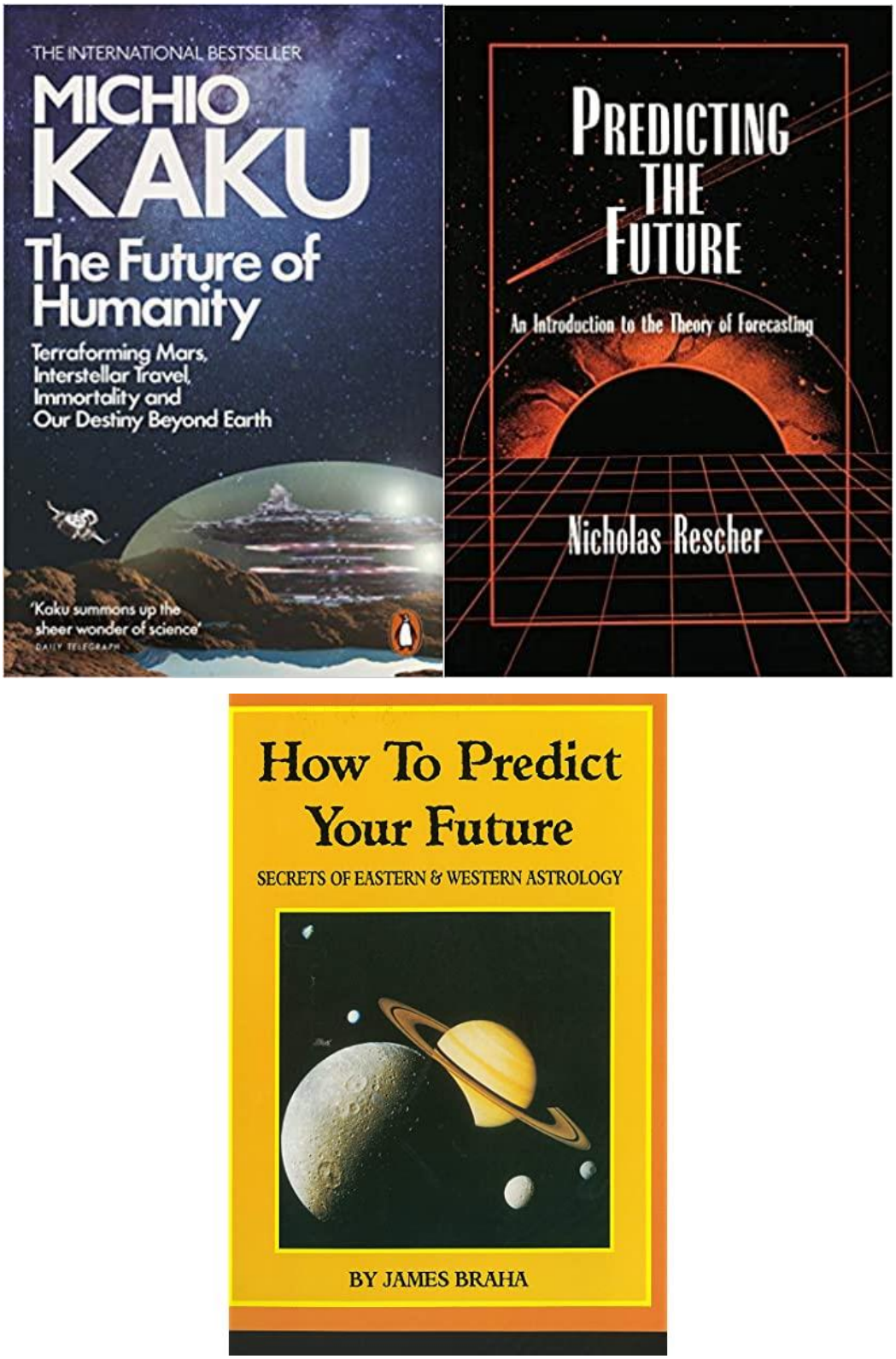


Figure 3.3: Michio kaku, Nicholas Rescher and James Braha's books

Erik Wernquist, a Swedish character animator, writer and director inspired me the most through his work for making this short film for my final project. Erik Wernquist has been making CGI shorts on theory and hypothesis since 2013 or around that time. Some of his works that inspired me are Wanderers (2014), A Warm Place (2018), Opening sequence of The High Frontier (2021), Go Incredibly Fast (2022)

Figure 3.4: Erik Wernquist CGI works

Some movie list that I have seen and inspired me:

- 2001: A Space Odyssey (1969)
- Andromeda Strain (1971)
- Contact (1997)
- Deep Impact (1998)
- Minority Report (2002)
- Wall-E (2008)
- Her (2013)
- Interstellar (2014)
- The Martian (2015)
- Arrival (2016)
- Rick and Morty
- A Trip to the Moon (1902)
- A.I. Artificial Intelligence (2001)
- District 9 (2009)
- High Life (2019)
- Edge of Tomorrow (2014)
- Star Trek (2009)
- Annihilation (2018)
- Primer (2004)
- Blade Runner 2049 (2017)
- Ex Machina (2015)
- The Fifth Element (1997)
- Akira (1988)
- The Terminator (1984)
- Back to the Future (1985)
- Back to the Future, Part II (1989)
- The Matrix (1999)
- Star Wars Episode V: The Empire Strikes Back (1980)

3.3 Theory on timeline of the short film

In 1963, the Russian astrophysicist Nikolai S. Kardashev came up with a hypothetical way to understand just where exactly we fit in. He developed what is now referred to as the Kardashev Scale, a system for gauging a civilization's technical prowess based on the quantity of energy it is able to harness. Kardashev created a three-level scale based on the quantity of energy a civilization could harness to describe the possible level of its development. On this scale were:

1. A Type 1 civilization, also referred to as the planetary civilization, is able to use all of the energy available on its home planet, including all solar energy and all of the energy it can generate (thermal, hydro, wind, etc.). It had "technical level close to the one currently obtained on the Earth," according to Kardashev. A global civilization, according to physicist Michio Kaku, should be able to manage things like earthquakes, the weather, and volcanoes and would be developing ocean cities. In that scenario, we still have a way to go. According to Kaku, it will take another 100–200 years for us to reach Type 1 level. According to Carl Sagan, we are currently only 0.7 steps away from type 1 space.

2. Once we reach Type 1, we'll probably depart Earth in search of energy sources on other worlds. We would advance to type 2 civilization if we were able to establish an extraterrestrial civilization that could utilize a star's whole energy potential. One way to do that is by building a Dyson Sphere-style megastructure around a star is one approach to use its energy. It would be able to completely envelop a star, absorb all of its energy, and then transmit the energy to the planet's surface for consumption.

3. A type 3 civilization is of an entirely different evolutionary order and takes possibly 100,000 years or more to reach. According to Kardashev, it would be "a civilization with energy on the scale of its own galaxy." Yes, in order to get this advanced, you must obtain the energy of an entire galaxy. By then, humans would have likely evolved into some type of post-biological cybernetic being by that time. [5]

From the theory and discussion from above, we can see that a type 3 or 2 civilization is far more away than we can imagine. And probably they sound like fairy tale in today's time. But we are going there at some degree. We already managed to make reusable rockets and probably we will be a multiplanetary species in near future. That will include us as a type 1 civilization. My short film takes place in that timeline. I wanted to show which is more sensible in today's time and with the knowledge we have right now. And may be there will be a time soon, where human would be doing such things as shown in the short film.

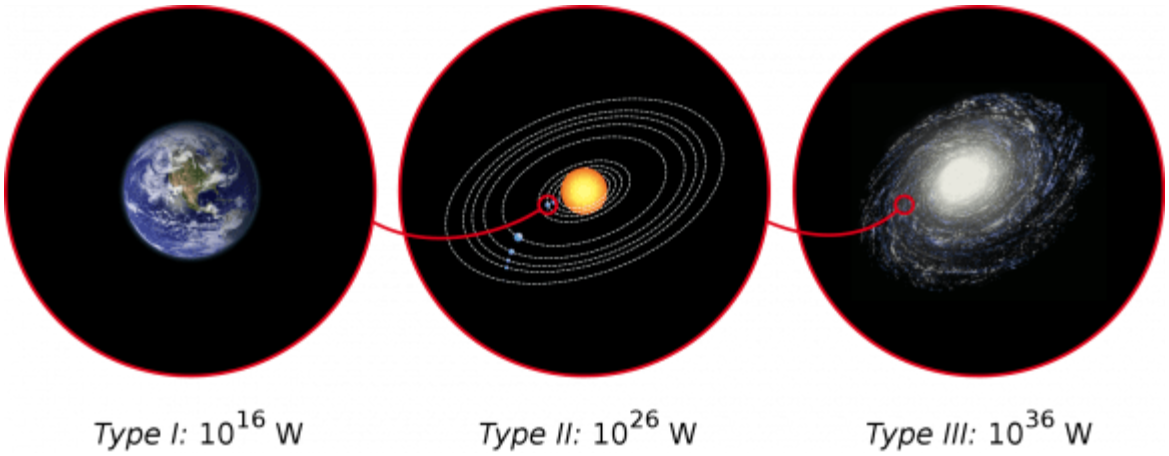


Figure 3.5: Three types of Kardeshev civilizations

3.4 Objectives

Objectives of making this short film can be viewed in many ways. In the making of the film, these are some of objectives that I hoped to achieve:

- To make a good quality animated short that can be placed among other work in the industry
- To understand animation workflow
- To understand high quality rig with IK system
- To Make good quality simulation works
- To work on rendering process that is one of the most powerful segments
- Developing a personal production pipeline that can help individual artists
- And most importantly, making a short film that is based on theory and hypothesis
- To make a narrated film using the great carl Sagan's voice

In the sense of making an impact on the audience of this film, these are some of the objectives: Encouraging people to wonder about the beautiful future that we can have

- To make people more interested in space science and cosmos
- To make a good visualization for the people who are interested in or studying on human development that can be occurred in future
- To trigger interest to dig deeper and learn more about hypothesis on human evolution
- to show a glimpse of the fantastic and beautiful nature that surrounds us on our neighboring worlds - and above all, without any apparent story, other than what audience may fill in by themselves

CHAPTER 4

PRE-PRODUCTION

I adhered to an industry-standard production line to ensure Multiplanetary life's maximal output in order to secure the long-term viability.

4.1 Story

The story is based on the hypothesis idea of evolution of human being colonizing on other planets to not get cease to exist. My target was to make this on actual thesis based on Nasa, Space X and other planetary research organizations. And to give that original vibe, I wanted to add a narrative to the film. And what's better than using an actual scientist's narration? I researched on the narrative and found the beautiful narration done by Carl Sagan (astronomer, planetary scientist, cosmologist, astrophysicist, astrobiologist, author) which is called "a message to mars". The story will first show the human evolution from being early men in cave to modern men in this new generation. To give an idea how human always been explorers. And then it will show how we can be colonized in mars or other planets. The scenes will be visualized in a way that it will do justice to the overall film idea and the narration. I also added some line form Carl Sagan's audio book "Pale blue Dot"

Here is the transcript of the narration that was put together for the short film.

"For 99.9 percent of the time since our species came to be, we were hunters and foragers, wanderers on the savannahs and the steppes. We were bounded only by the Earth and the ocean and the sky. In the last ten thousand years an instant in our long history we've abandoned the nomadic life. Science and science fiction have done a kind of dance over the last century, particularly with respect to Mars. I don't know why you're on Mars. maybe we're on Mars because we recognize that if there are human communities on many worlds, the chances of us being rendered extinct by some catastrophe on one world is much less. maybe we're on Mars because of the magnificent science that can be done there - the gates of the wonder world are opening in our time. Maybe we're on Mars because we have to be, because there's a deep nomadic impulse built into us by the evolutionary process, we come after all,

from hunter gatherers, and for 99.9% of our tenure on Earth we've been wanderers. And, the next place to wander to, is Mars."

The story goes with this transcript to show the visual of the imagination that Carl Sagan referring here. This show the very beginning of us being as a multiplanetary species.

All the stories for each scene are given below:

4.1.1 (Scene1) Savannah

Some people from early age which around 10,000BC are going to a specific shrine place, where they pray to stars. These people from early age thinks stars are God since they do not know anything better. They lit the area using fire and pray to stars, specially the "Sirius Star" for better weather, food availability and Survival chance.

Narration:

"For 99.9 percent of the time since our species came to be, we were hunters and foragers, wanderers on the savannahs and the steppes. We were bounded only by the Earth and the ocean and the sky."

4.1.2 (Scene2) Sky Transition

The sky is moving and showing timelapse of days and night. Years have passed and now we are in 2030. A high-tech Cargo flying Ship is coming from that exact sky after the Centuries Transition.

Narration:

"In the last ten thousand years an instant in our long history we've abandoned the nomadic life"

4.1.3 (Scene3) Polar Present

Some modern-day scientists are running an expedition in the exact same place where early men were used live and pray. These scientists wear astronomer suits because earth is almost too toxic right now to live and breath casually. They somehow find some evidence of early men praying to the stars.

No Narration

4.1.4 (Scene4) Mars

One of the mars rovers that NASA sent to mars, wanders on mars surface. It runs on a higher surface of mars and then stopes at edge of the cliff. Mars has already been colonized.

Narration:

"Science and science fiction have done a kind of dance over the last century, particularly with respect to Mars. I don't know why you're on Mars."

4.1.5 (Scene5) Multiplanetary Human

People has reached to a point that now they live in mars and probably going to live in other planets. An astronaut watching earth being destroyed by an asteroid that is heading towards earth from a spaceship hangar.

Narration:

"Maybe we're on Mars because we recognize that if there are human communities on many worlds,"

4.1.6 (Scene6) Doomsday

For many reasons, there are a lot of people left in earth. Maybe they are poor to go to mars. Maybe they chose to stay in earth which they believe is the only home and its beautiful. Or may be some of them are protestors who were not in the support of human being multiplanetary and spending immense amount of money on it where they had a lot of problems in earth itself. They built Aftermath organizations to maintain whatever is left on earth. Unfortunately, this is the day its all going to go. And they understand that they have nothing to do about it except embrace the reality and their future.

Narration:

"The chances of us being rendered extinct by some catastrophe on one world is much less."

4.1.7 (Scene7) Home Sweet Home

Watching the place which has been the sweetest home of us for around 2.5mllion years, The astronaut feels pain and sadness.

No Narration

4.1.8 (Scene8) Development on Mars

Mars has been developed as a fully sustainable planet for live in and maintain the legacy of human life. People now do science experience and invention on mars. There are space station and scientific development on mars just like it was once on earth. But now they are more organized and planned for future.

Narration:

"Maybe we're on Mars because of the magnificent science that can be done there,"

4.1.9 (Scene9) To the other sides

A spaceship that is big enough to hold good amount people, enough for starting a new colonization going through a wormhole that is discovered by advanced human living in mars. They hope to find another galaxy on the other side with planets that is similar to earth.

Narration:

"The gates of the wonder world are opening in our time."

4.2 Script

The script was written in industry level format using Courier font, 12-point size, single spaced. This is to gain knowledge on how filmmakers or writers deal with a script.

EXT. CANYON/SAVANNAH/STEPPES-NIGHT

This first scene will show the human evolution in some few seconds. How we used be bounded only by our surroundings and the our curiosity to explore the world let us become the most advanced species.

CARL SEGAN (NARRATOR)

"FOR 99.9% OF THE TIME SINCE OUR SPEICES CAME TO BE, WE WERE HUNTERERS AND FORAGERS, WANDERERS IN THE SAVANNAHS AND THE STEPPES. WE WERE BOUNDED ONLY BY THE EARTH,AND THE OCEAN AND THE SKY."

(4-6 men sitting before a sculpt of stone or something like that. staring at the stars and pointing two hands towards the sky . it should look like they are worshiping the big star)

THE CAMERA WILL PAN FROM GROUND VIEW TO STRAIGHT VIEW AND MEANWHILE THE MEN WILL BE SHOWN WORSHIPING THE STAR. THE CAMERA WILL KEEP GOING FAST FOLLOWING THE MENS HANDS TO THE SKY STARS (SIRIUS MAINLY)

EXT. SKY/MOUNTAIN/ENVIRONMENT CHANGES

The sky will be moving and showing time-lapse of days and night. Years have passed and now we are in 2030. A high-tech Cargo flying Ship is coming from that exact sky after the Centuries Transition.

Figure 4.1: Script page (1)

CARL SEGAN (NARRATOR)

"IN THE LAST 10,000 YEARS AN INSTANT IN OUR LONG HISTORY, WE ABONDENT THE NOMADIC LIFE."

(a space ship coming from the sky passing by the camera which was pointing to the sky, and landing on the ground. some humans dressed as astronaut digging to collect fossil of earlymen/cavemen. 1-2 person examining the collected fossil with advanced technology and screens)

THE CAMERA WILL TURN AROUND AGAIN THE SPACESHIP PASSES BY IT, AND IT WILL SHOW THE ENTIRE ENVIRONMENT IS CHANGED AND EVOLVED THROUGH MANY CENTURIES. THEN OVERALL LONG SHOT OF THE ENVIRONMENT AND ADVANCED HUMAN AND SOME CLOSE SHOT OF THEIR WORKING SCENE.

EXT. MARS SURFACE/ MARS ENVIRONMENT

CARL SEGAN (NARRATOR)
"Science and science fiction have done a kind of dance over the last century, particularly with respect to Mars."

(one/two astronaut driving a exploration vehicle on mars surface. The mars is colonized)

THE CAMERA WILL DO A LOWER ANGLE(CLOSE TO GROUND) DOLLY SHOT FROM FAR TO CLOSE TO THE VEHICLE WHILE THE VEHICLE IS MOVING. THE VEHICLE WILL STOP AT THE EDGE OF THE SURFACE(LIKE A MOUNTAIN SURFACE). AND THEN THE CAMERA WILL SHOW THE LOWER MOUNTAIN SURFACE WHERE EVERYTHING IS COLONIZED.

Figure 4.2: Script page (2)

EXT SPACE ENV /EXT. EARTH-EXPLOSION ENV

People has reached to a point that now they live in mars and probably going to live in other planets. An astronaut watching earth being destroyed by an asteroid that is heading towards earth from a spaceship hangar.

CARL SEGAN (NARRATOR)

"Maybe we're on Mars because we recognize that if there are human communities on many worlds,"

(astronaut in a spaceship watching earth exploding. Left people on earth watching(soon to be cease to exist) explosion caused by a big asteroid.)

THE CAMERA WILL SHOW THE EARTH EXPLOSION REFLECTION ON THE ASTRONAUT'S HELMET GLASS. AND SHOW A EXPRESSION OF AGONY/CRYING(BECAUSE EARTH/HOME IS EXPLODING). THEN CAMERA WILL SHOW THE PEOPLE ON THE EARTH WHO HAS NOTHING TO DO BUT ACCEPT THE FATE.

EXT. DYSTOPIAN EARTH/LEFTOVER HUMANS

For many reasons, there are a lot of people left in earth. Maybe they are poor to go to mars. Maybe they chose to stay in earth which they believes the only home and its beautiful. Or may be some of them are protestors who were not in the support of human being multiplanetary and spending immense amount of money on it where they had a lot of problems in earth itself. They built Aftermath organizations to maintain whatever is left on earth. Unfortunately, this is the day its all going to go. And they understand that they have nothing to do about it except embrace the reality and their future.

Figure 4.3: Script page (3)

CARL SEGAN (NARRATOR)

"The chances of us being rendered extinct by some catastrophe on one world."

(people watching big asteroid falling in front of them. Aftermath global organization giving goodbye mass)

Camera will pan from top view to soldier view with camera shake input

EXT SPACE ENV /EXT. EARTH-EXPLOSION ENV

Watching the place which has been the sweetest home of us for around 2.5mllion years, The astronaut feels pain and sadness.

CARL SEGAN (NARRATOR)

"is much less"

(astronaut being sad, putting hands on the glass of the spaceship hanger. crying with one tear drop)

CAMERA WILL ZOOM IN FROM OUTSIDE THE SPACESHIP HANGER SLOWLY

Figure 4.4: Script page (4)

EXT. MARS PLANET VIEW FROM SPACE

Mars has been developed as a fully sustainable planet for live in and maintain the legacy of human life. People now do science experience and invention on mars. There are space station and scientific development on mars just like it was once on earth. But now they are more organized and planned for future.

CARL SEGAN (NARRATOR)

"Maybe we're on Mars because of the magnificent science that can be done there,"

(A spaceship or space station flying above mars planet surface. Mars is colonized in futurist style)

SIMPLE STILL CAMERA SHOT TO SHOW THE SPACESHIP AND THE MARS SURFACE UNDERNEATH THE SHIP

EXT. SPACE/WORMHOLE/STARS ENVIRONMENT

A spaceship that is big enough to hold good amount people, enough for starting a new colonization going through a wormhole that is discovered by advanced human living in mars. They hope to find another galaxy on the other side with planets that is similar to earth.

CARL SEGAN (NARRATOR)

"The gates of the wonder world are opening in our time."

(Spaceship seems too small going through a wormhole. The wormhole looks like its warping space)

SIMPLE CAMERA SHOT TO SHOW EVERYTHING ON THE SCENE

Figure 4.5: Script (5)

4.3 Reference for scenes

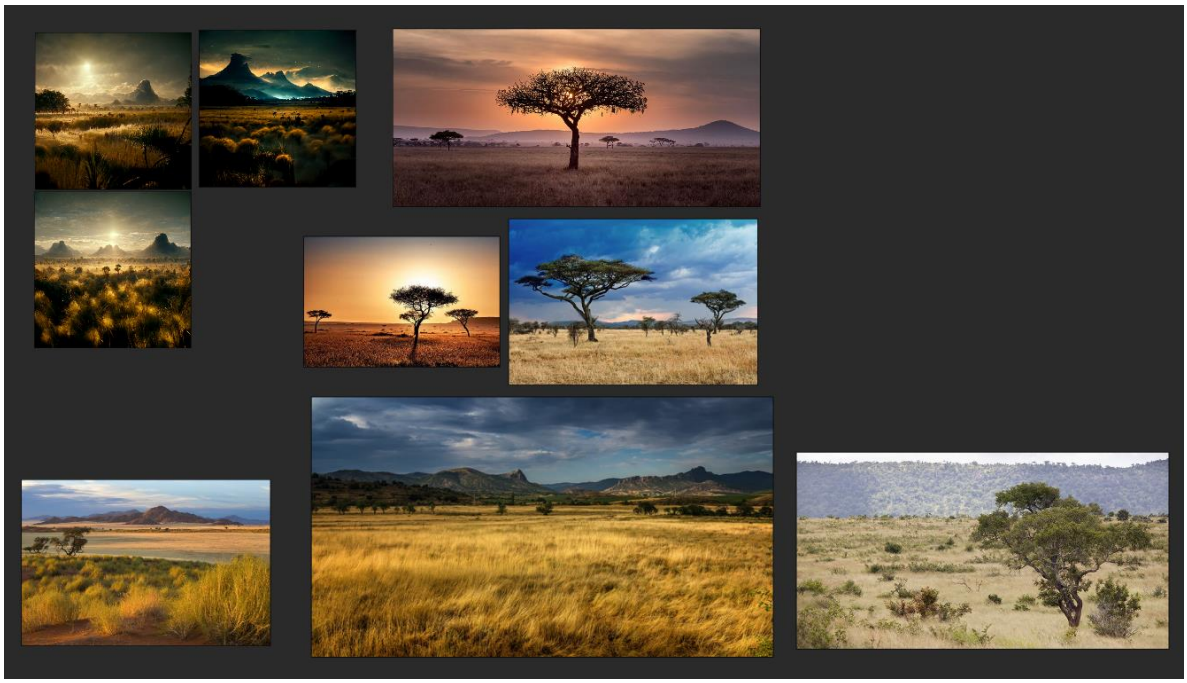


Figure 4.6: References for scene Savannah

Figure 4.7: References for scene Polar Present

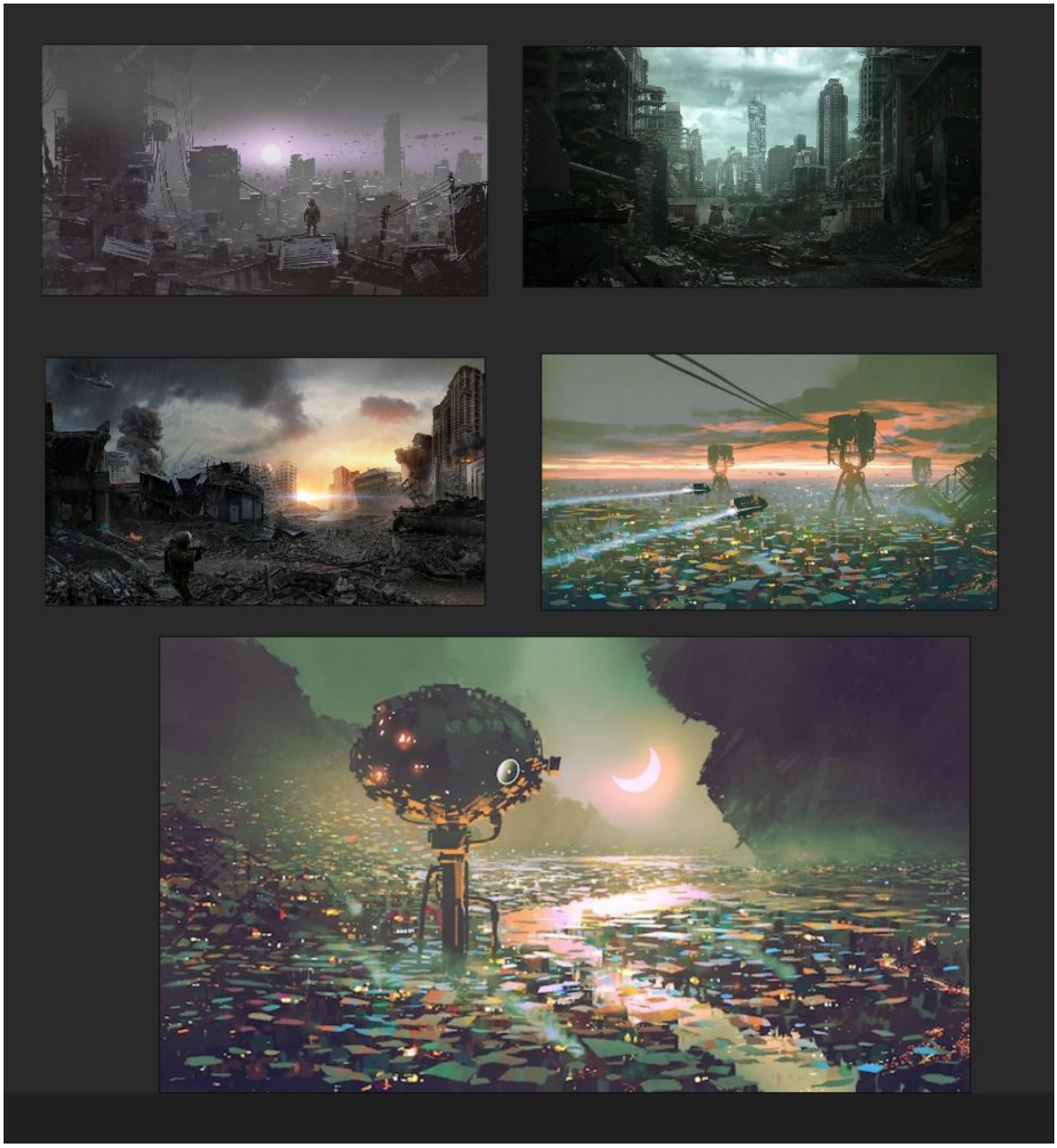


Figure 4.8: References for scene Doomsday

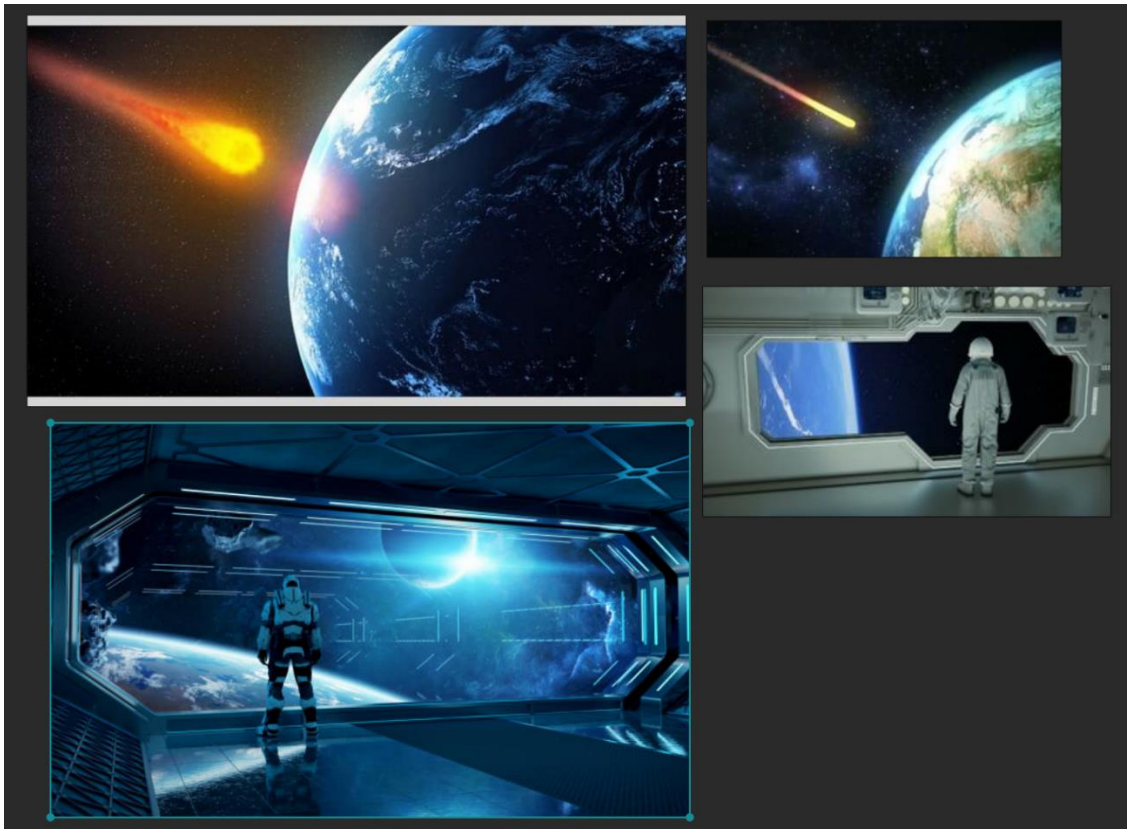


Figure 4.9: References for scene Home sweet Home

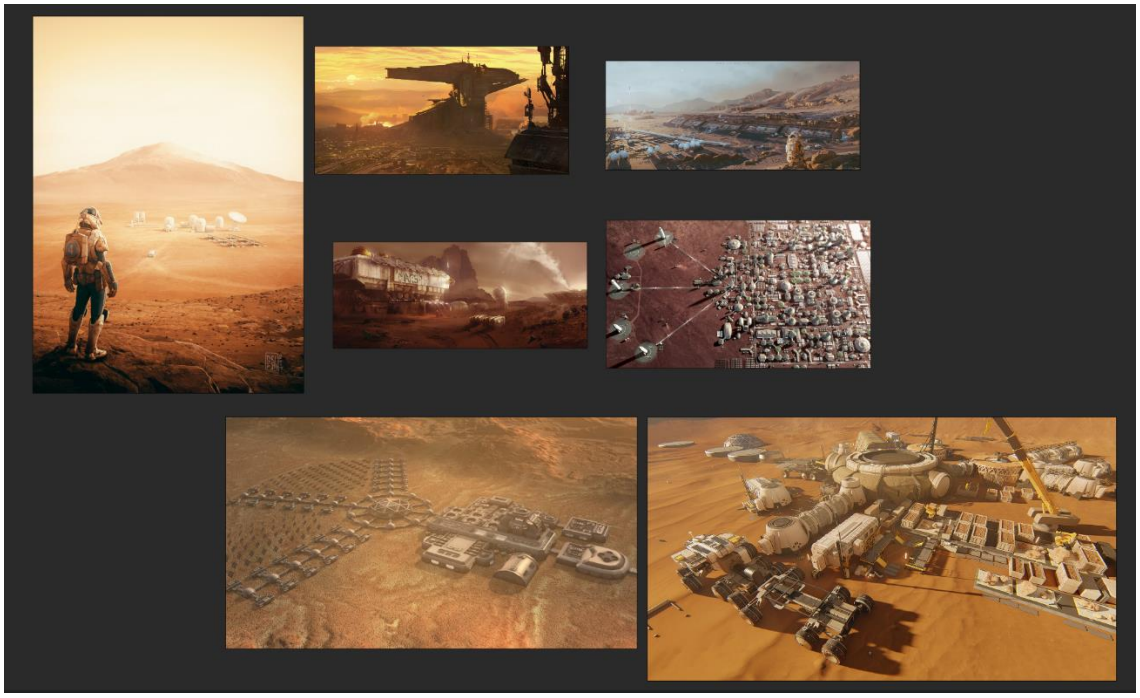


Figure 4.10: References for scene mars

4.4 Audio work for narration

For the first portion of the narration. I had to buy and download an audio book of Carl Sagan called “Pale blue dot”. The audio was not in mp3 format because the website called audible provides the audios in an encrypted format. I had to decrypt it in order to get the first portion of the narration. To do that, I used a software called “Epubor”. It simply adds any audio book and can convert them into mp3. It can also split the audios in chapters.

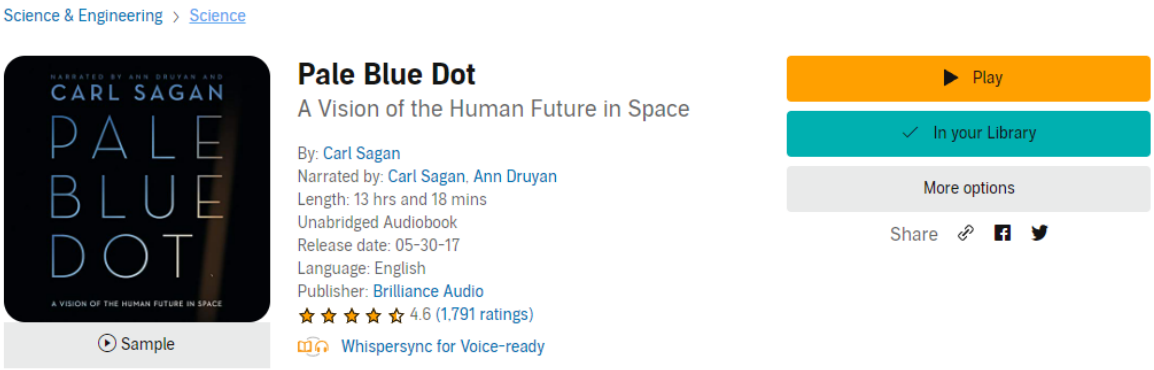


Figure 4.11: Audio book “Pale Blue Dot”

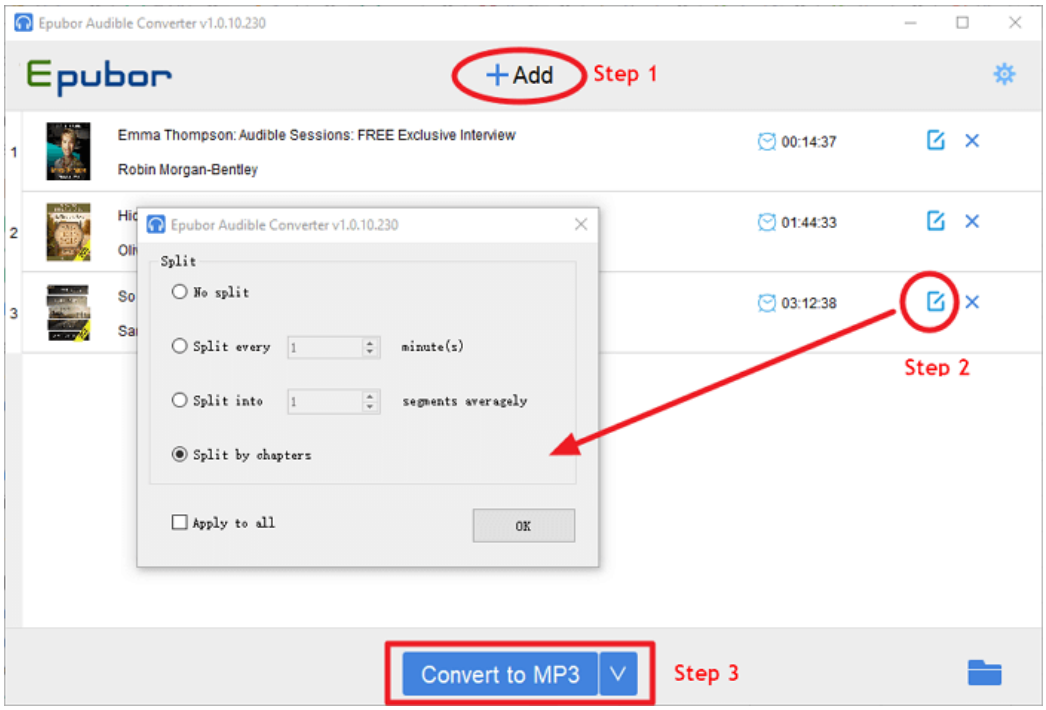


Figure 4.12: Epubor audio book converter

It was kind of hard work to make the audio from “A message to mars” which is a big portion of the narration. It was recorded with old technology and it had a lot of sound from the nearest waterfall. For the short film, the narration has to be crystal clear. That’s why I used adobe audition to clear out all the noise and other things, and make the more vibrant.

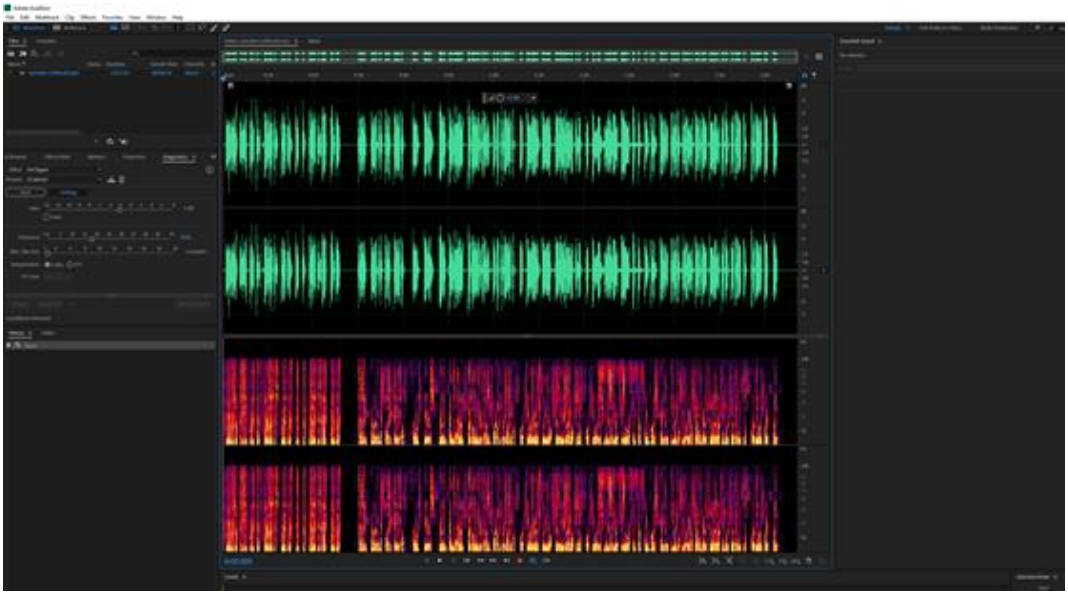


Figure 4.13: Adobe Audition Sound mixing

Many equalizers available in Adobe Audition to see which ones is more preferable to use to cut down on background noise. One octave, one-half octave, and one-third octave equalization settings are available in Audition.

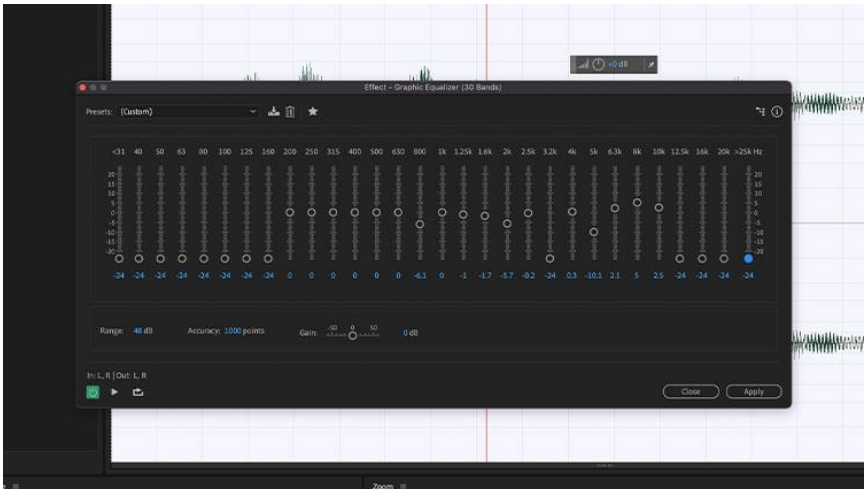


Figure 4.14: Adobe Audition Equalizer

CHAPTER 5

RESEARCH ON EACH SCENE

Because the entire short film is based on hypothesis and practical theory we have now. I had to do a good number of researches on each scene to make it more genuine and logical.

All the researches are on each scene are described below:

5.1 Savannah

The idea of this scene showing early men came to my mind sometimes ago. But which location I should show came to me from research called "**Introduction to Human Evolution**" by Smithsonian national museum of Natural history. It says that very early men used live in Africa, especially the places called "Savannah". This is why I tried to make an environment that is much similar to savannah. [6]

From research called "**The ancient wonder and veneration of the dog star Sirius**", I got to know that early men and ancient people used to worship a star called "Sirius". All throughout human history, ancient peoples have marveled at and revered Sirius, the brightest star in our sky. Since Sirius is prominent in the constellation Canis Major, it is frequently referred to as the "Dog Star" (Greater Dog). Strangely, the blazing Sirius has always been identified with either a wolf or a dog by ancient civilizations with no apparent relationship. They used to worship this star for greater life style, good environment, rain and food. Early men used to think stars are God. This is one them. From here I took the idea and put the star in the scene, where the early men worship the pattern of the star.

Figure 5.1: Sirius Star

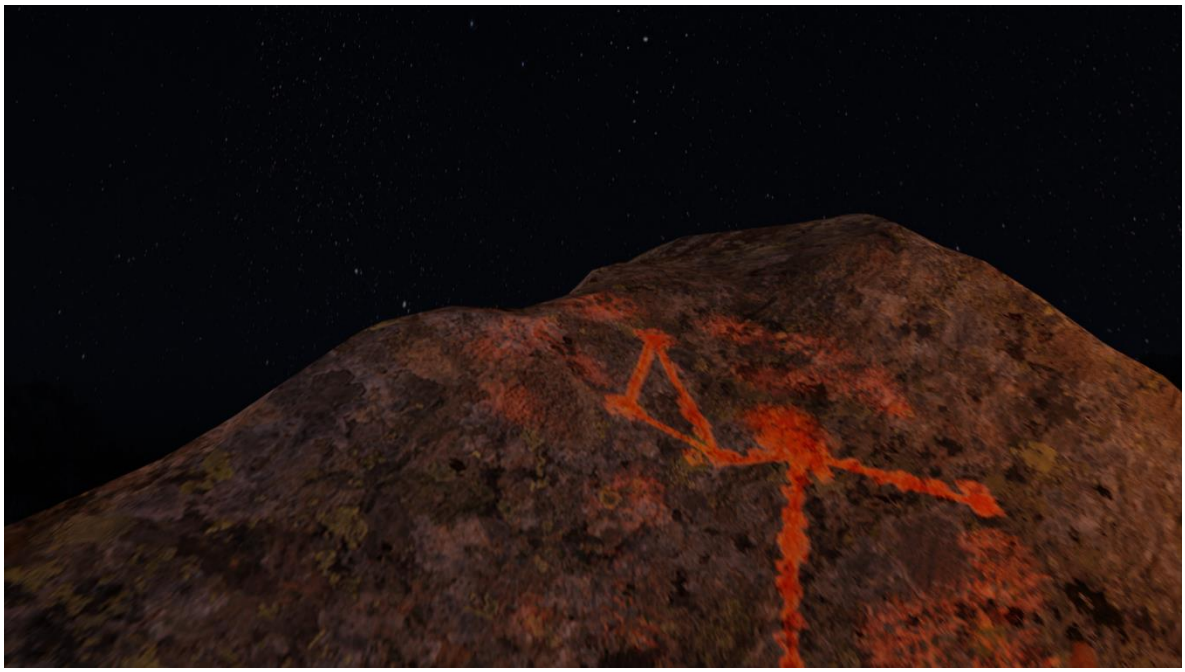


Figure 5.2: Sirius Star Earlymen Drawing

5.2 Sky Transition

For the day and night transition, I had to look for something mathematical that would allow me to create drives for sun and moon. Because we already know sun and moon position depends on some fixed position and rotation. Aristarchus of Samos Greek mathematician and astronomer who is celebrated as the exponent of a Sun-centered universe and for his pioneering attempt to determine the sizes and distances of the Sun and Moon. Aristarchus tried to learn about sun and moon position, rotation and elevation using trigonometry. After learning about this, I tried to find a solution for that. And luckily, in blender cloud system, I found a drive which indicates that if we use

pi/2-atan2(sqrt(x*x+y*y),z) For sun elevation

and, -atan2(-x,y) for sun rotation. We will get a good result of lighting which includes perfect degree of elevation depending on the sun rotation. That worked like a charm in blender Nishita sky driver

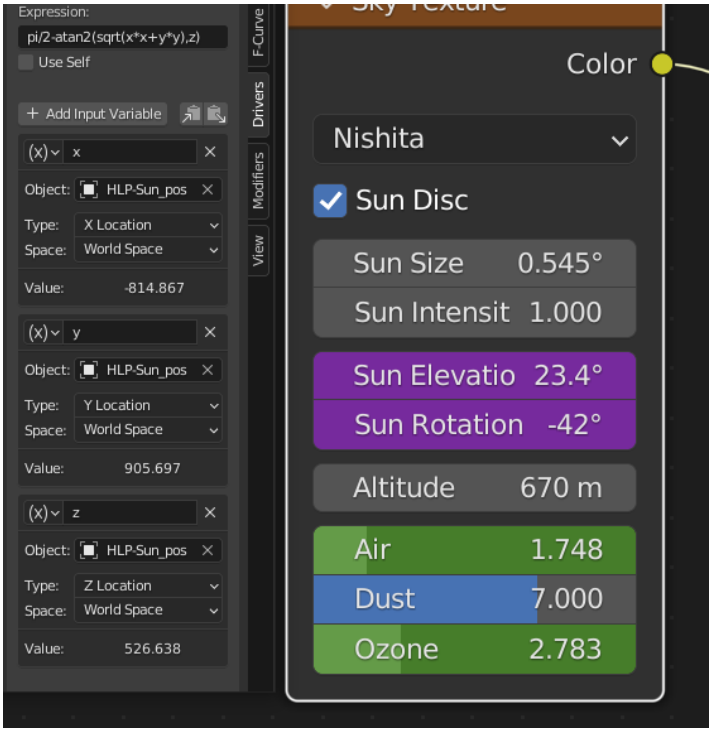


Figure 5.3: Blender Sun position drive

5.3 Polar Present

In this scene, I will be showing people the time when earth is frozen doing expedition on earth, and finding fossil rock that has painting of star done by early man which will be shown in the first scene “Savannah”. This scene will be in the same place but representing a glacier or icy environment since thousands of years had passed. And research shows that, when years passes, erosion happens and fossils or rock come up to earth surface. And then its easier to find and collect fossils. It is very likely that Earth will turn cold again, possibly within the next several thousand years

5.4 Mars

Based on research, it is possible to say that human life would go to mars and live there by the year 2040. And colonizing the mars would take another decade or two. After successfully landing on mars, there are some potentials discusses about the steps that we will be following and about how it’s going to look like on mars. Such as becoming self-efficient, forming a community, making a culture, building bigger rockets and updating technologies. This will start with by living in domes. I tried to show that in the film.

5.5 Multiplanetary Human

If complexity is "preferred" by the universe, then our planet has been a genuine diamond mine. For all we know at this point, the most advanced life forms in the cosmos originated on Earth. There is no branch of evolution that, according to the available scientific evidence, is more promising than our own. Ineffably complex forms of human and post-human life and technology will very likely arise if our earthly branch is permitted to persist. The underlying concept is that if we believe there is benefit (to the cosmos) in letting our branch of evolution to continue to develop and become more complicated in whatever ways, then we must make absolutely sure not to prematurely split this branch of evolution. "Existential risk" was defined by Dr. Nick Bostrom in his groundbreaking 2002 study.

He said “Existential risk – One where an adverse outcome would either annihilate Earth-originating intelligent life or permanently and drastically curtail its potential. An existential risk is one where humankind as a whole is imperiled. Existential disasters have major adverse

consequences for the course of human civilization for all time to come." This is exactly why we need to be a multiplanetary species. [8]

5.6 Doomsday

This scene was inspired by an episode called "Three Robots: Exit Strategies" from the series "Love Death and Robots". Also, many other movies which are based on hypothesis inspired this scene. If we ever become a multi-Planetary species, there will be a separation between human population. There will be some categories of human who won't make it to the other planets.

- People who would just want to live in earth
- People who won't believe in space exploration and spending money on it
- People who will be too poor to go to other planet or Mars

For those people will be in earth will not survive a huge catastrophe that can destroy the earth. And in those moment, they will highly likely will accept their fate. This scene basically represents that situation.

5.7 All other scenes

The next scenes of the film are also based on research, hypothesis and imagination. Such human will be exploring space and will colonize the mars fully. There will mars space station. At some point, human will find wormhole and ways to travel through it. The last scene represents, how we become what we are today, how we evolved ourselves from cave to modern world. We have always been explorers. And it's built into us by the evolutionary process that we never stay in one place without wandering what could be out there. This is exactly our next place to wander to is Mars

CHAPTER 6

PRODUCTION

I have developed the production process into two different types based on Blender production pipeline. And both of these two categories have many sub-categories.

1. **Asset Production**
    - Characters
    - Props
    - Environment asset library
2. **Shot Production**
    - Animation
    - Cloth simulation
    - Texturing
    - Rendering

6.1 Asset Production

The asset production goes all the time during the whole project, because the assets might change based on script requirements.

6.1.1 Characters

Because of it's a totally individual project, I had to makeup time by collecting assets. Nowadays there are many tools, softwares and addons that can generate character models and allows to edit the models. In this case most of the time I used a Blender addon which is from a software called "Human generator". I also collected character models from Patreon page of a 3d artist named Ian Hubert.

Figure 6.1: Characters made in Human Gen

Figure 6.2: Mixture of Sketchfab and Human Gen characters

Figure 6.3: Characters from Ian Hubert Patreon Page

6.1.2 Props

Most of the props were made in blender. Some of them were collected from online and modified. As an example, the torch here is modeled in blender and then attached with the fire simulation work. On the other hand, the scanner machine was collected but it was attached with the custom-made hologram work.

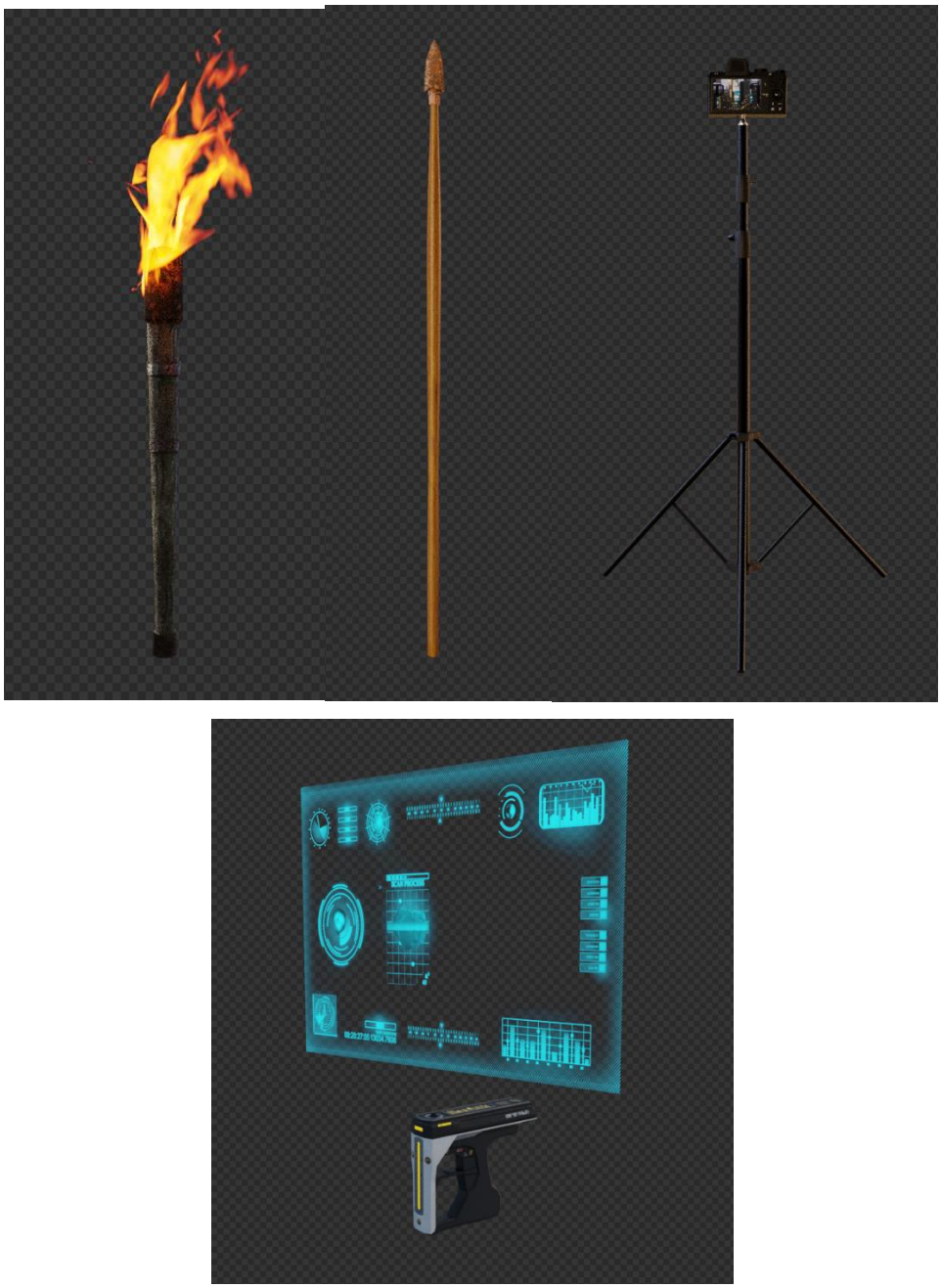


Figure 6.4: Props for characters

6.1.3 Environment Asset library

The most important part was in the project for me was to make good environment. I have never done any environment before this project, and I had to study a lot of things such as Volume, Environment lighting, Mist work, Clouds and sky, Cloud shadows and many other things. To make it happen, I had to collect a lot of free and paid assets for environment design. I also created Landscape in software named 'World Creator'. Apart from main assets which are time consuming to model, I created other elements such as rock, grass, Planets and other material in Blender. I used Blender addon called 'Botaniq'. Also, some of the assets were collected from Patreon pages of many artists and then I used Geometry node to use them. And last but not least, Quixel Mega scan helped a lot for collecting environmental assets. There is a addon called 'Bridge' that helps to download and easily import the assets in blender for better workflow.

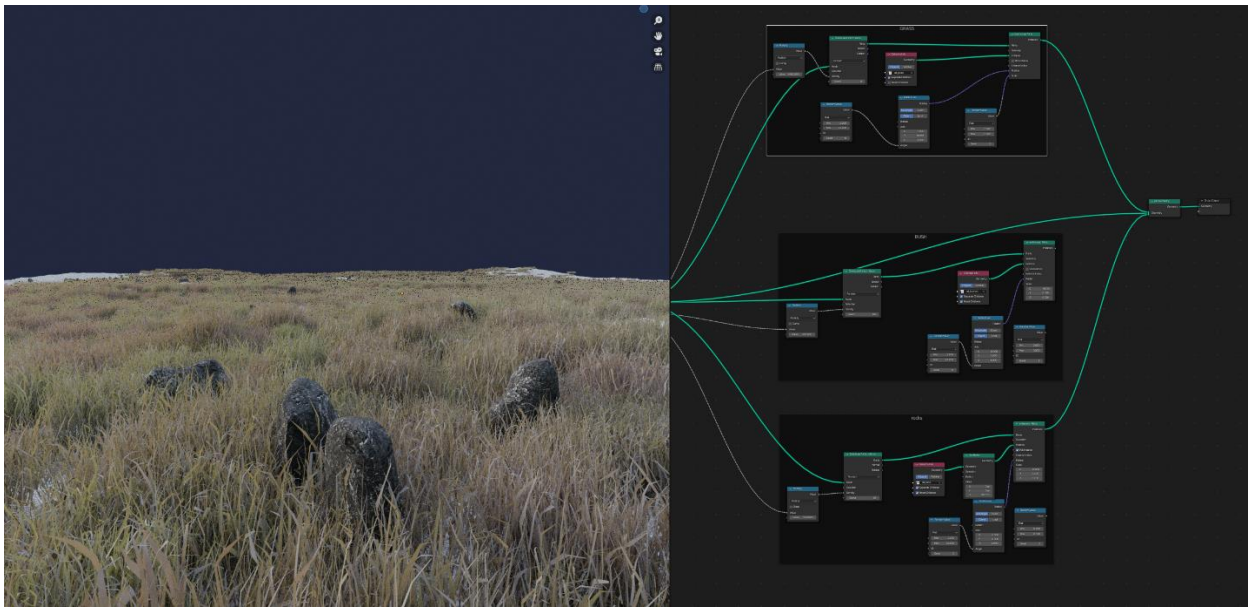


Figure 6.5: Vegetation assets created in Blender

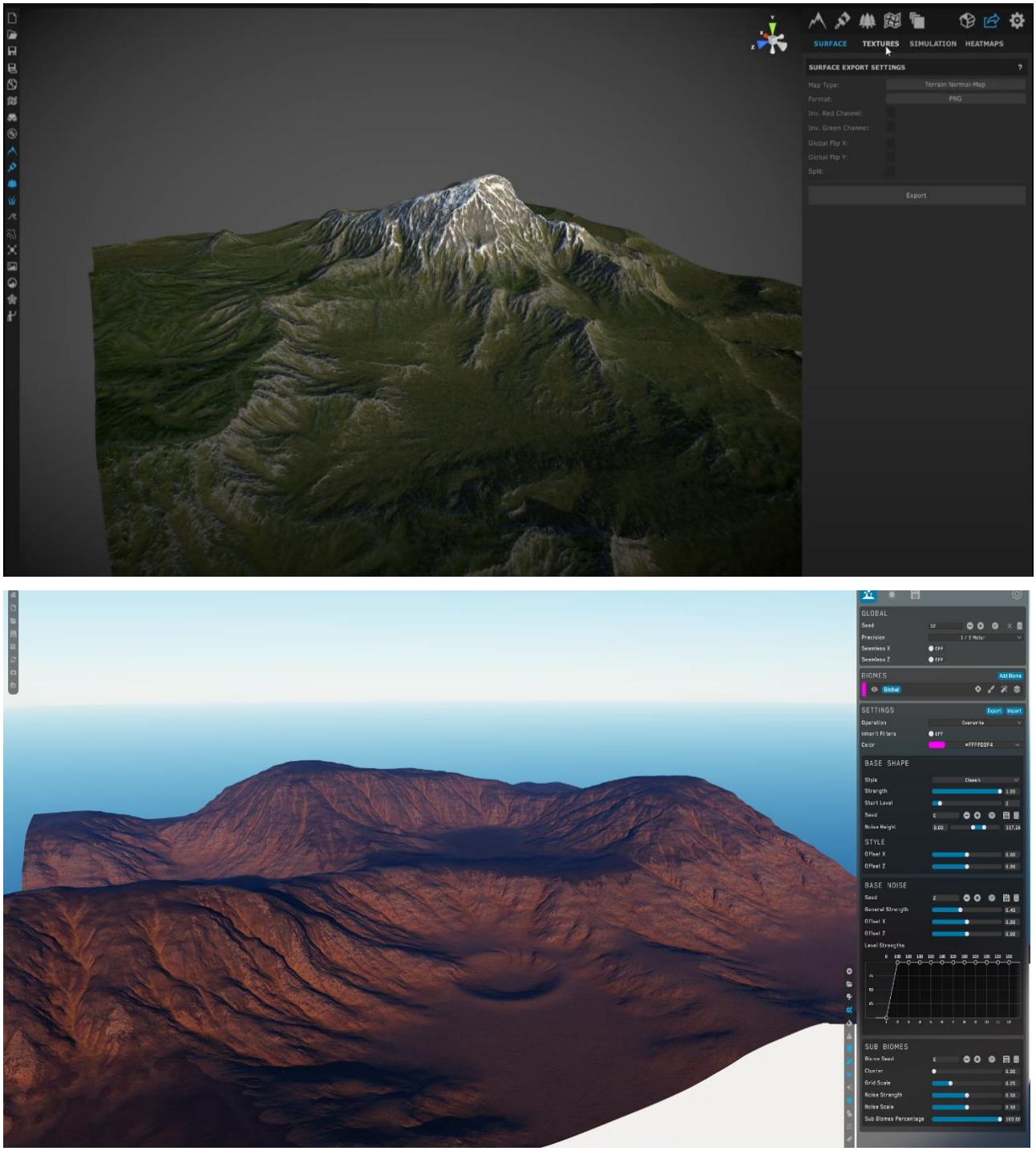


Figure 6.6: Terrain assets created in World Creator

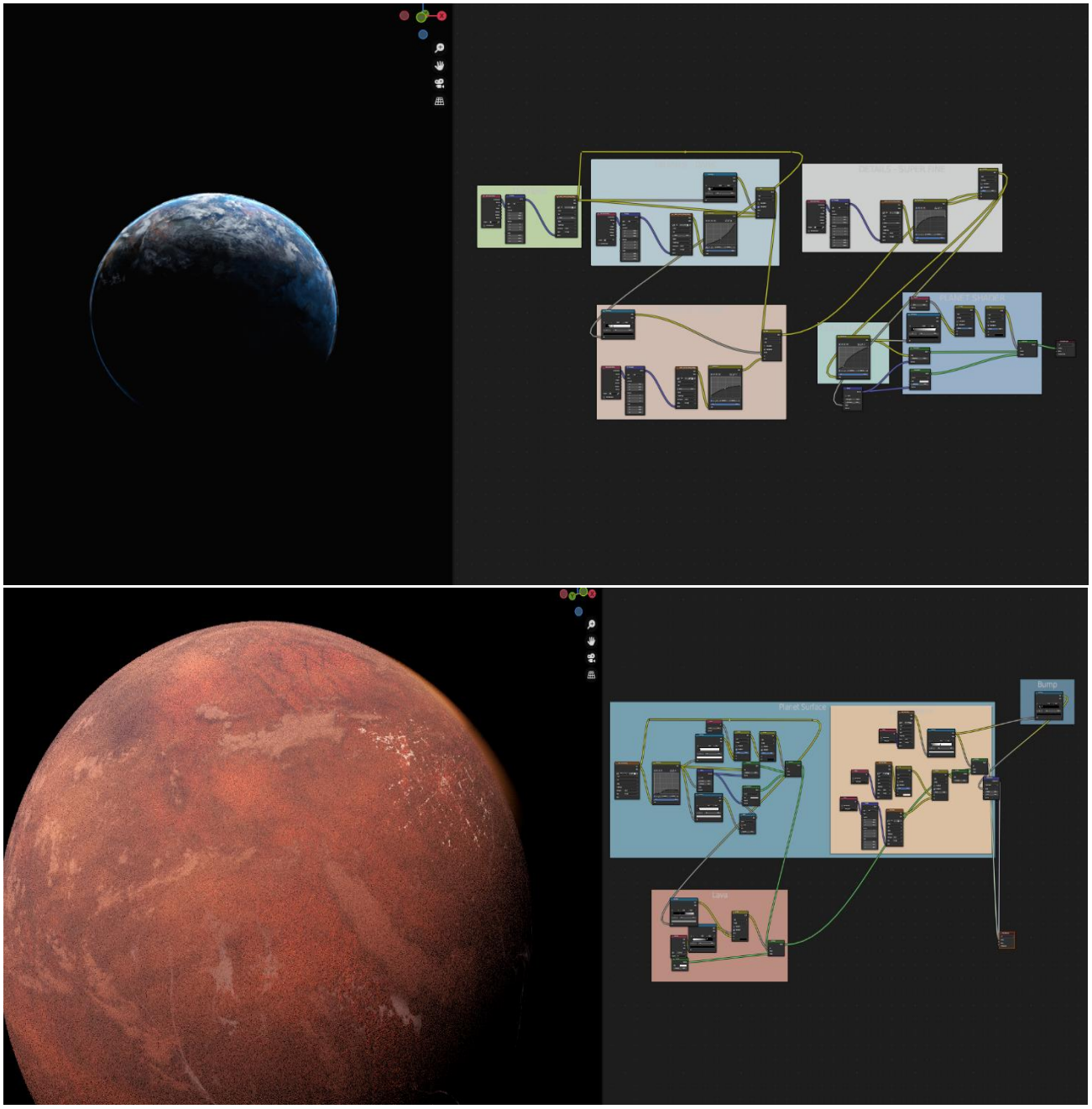


Figure 6.7: Planets created in Blender

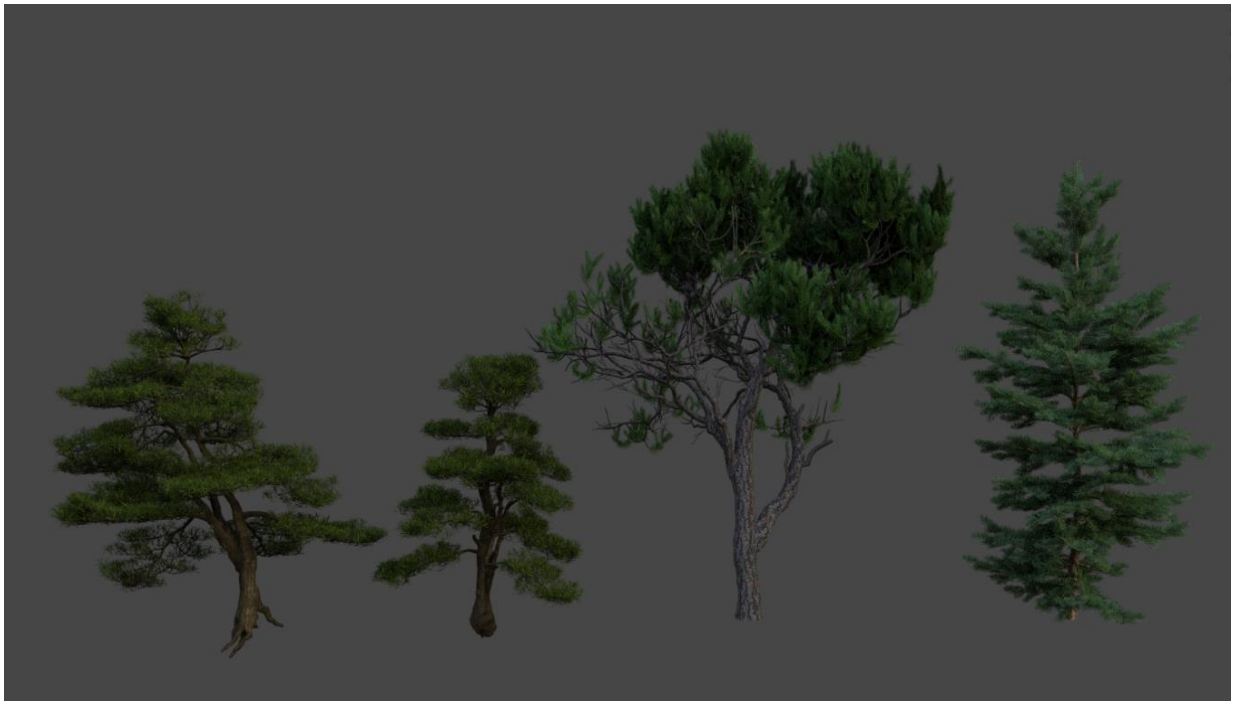


Figure 6.8: Tree assets from Botaniq addon

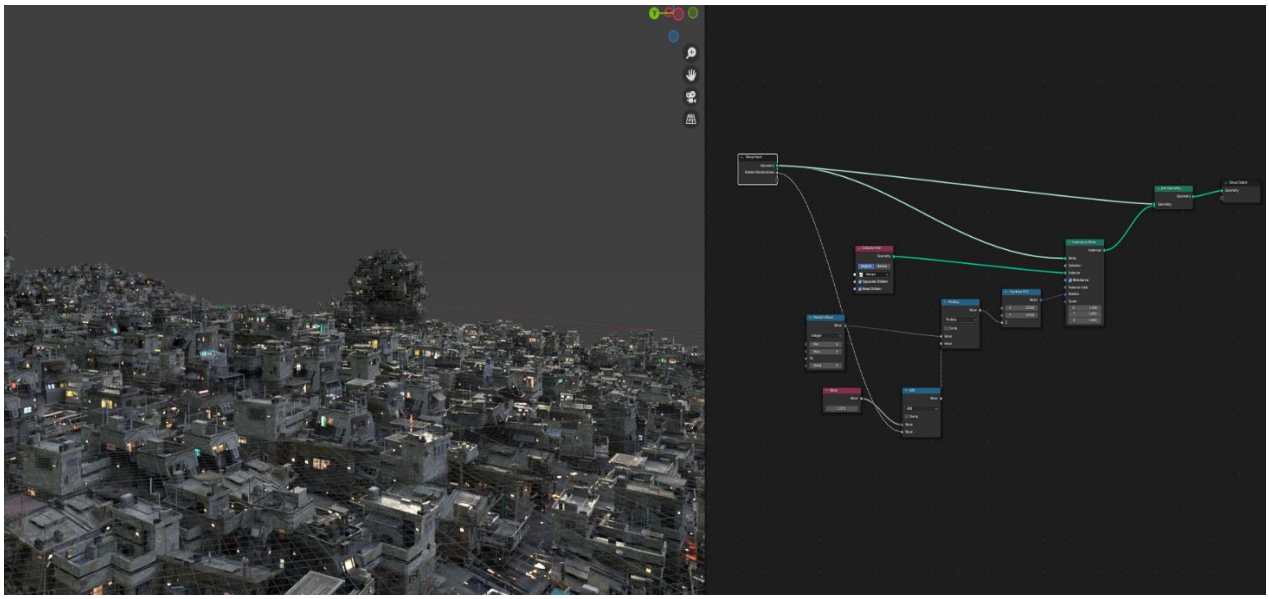


Figure 6.9: Patreon assets scattered by Geometry Nodes

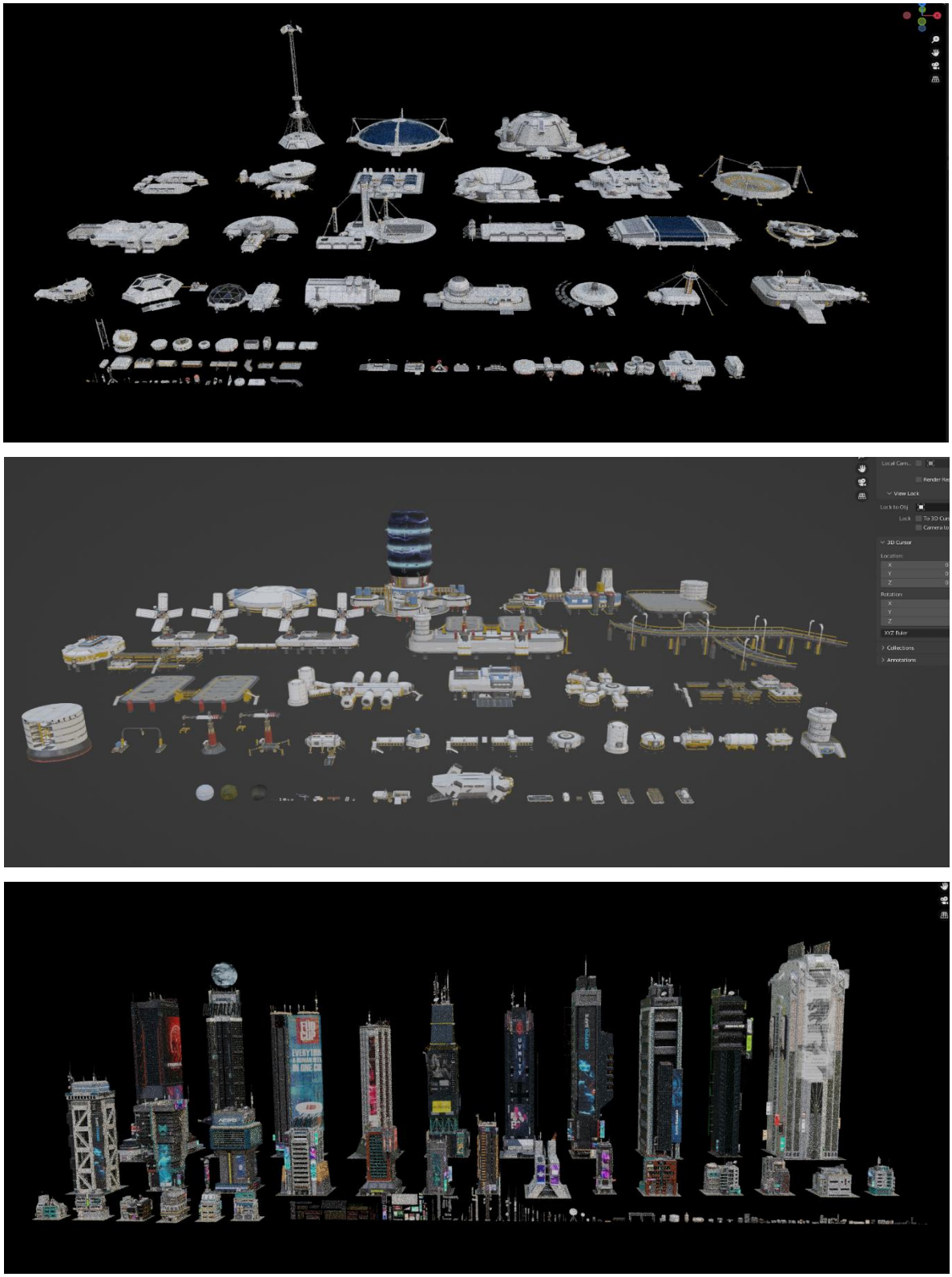


Figure 6.10: Paid and free assets from Kitbash3D

6.2 Shot Production

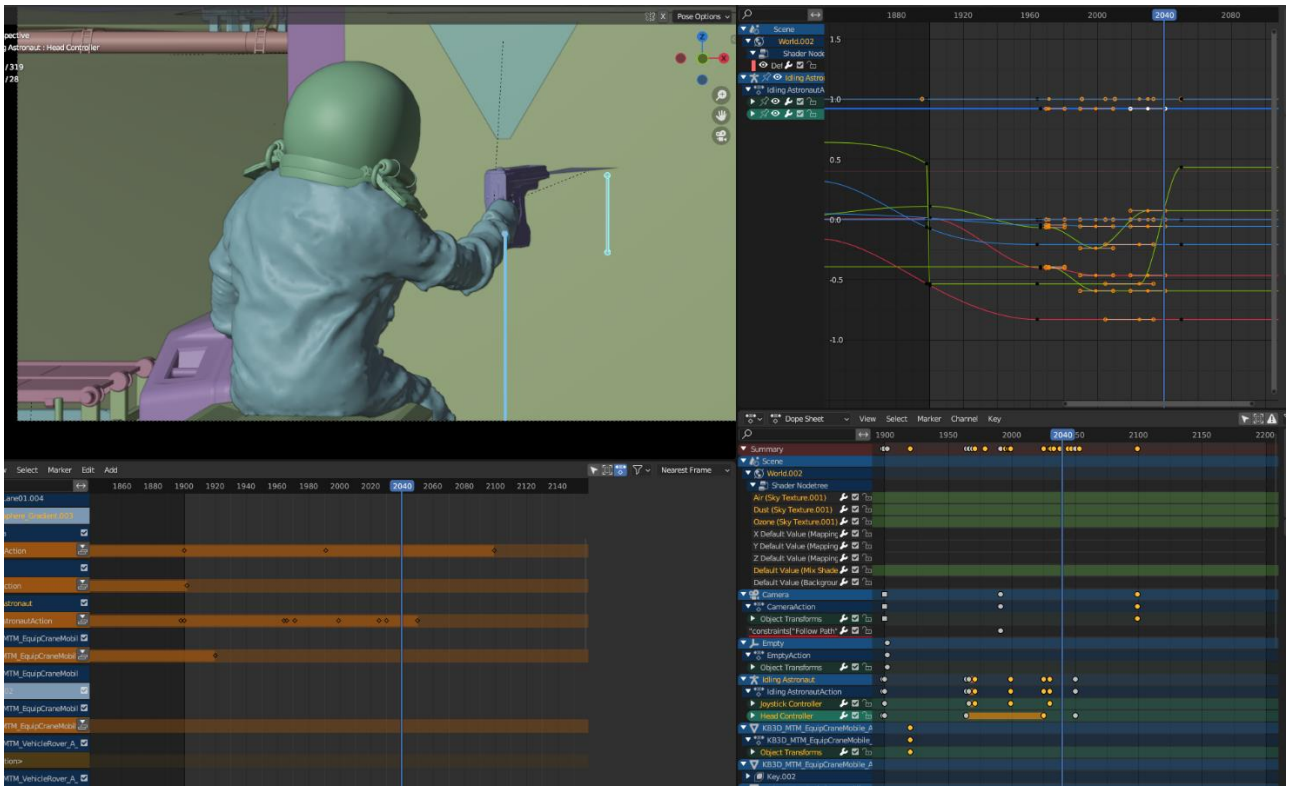
The shot production goes step by step to make an organized production work. This part includes every work in the project such as making the environments, animating characters, objects and camera shots, Texturing, lighting and rendering.

6.2.1 Animation

This part can be devided into two categories. Animation for characters and animation for other objects such as props, effects, moving things, vehicles, atmospheric animation and many more.

6.2.1.1 Character animation

The hardest part was to animate the characters. Because I wanted to animate them frame by frame and not by using Motion capture data. The tricky part was to make the facial expression animation which required hundreds of keyframes.



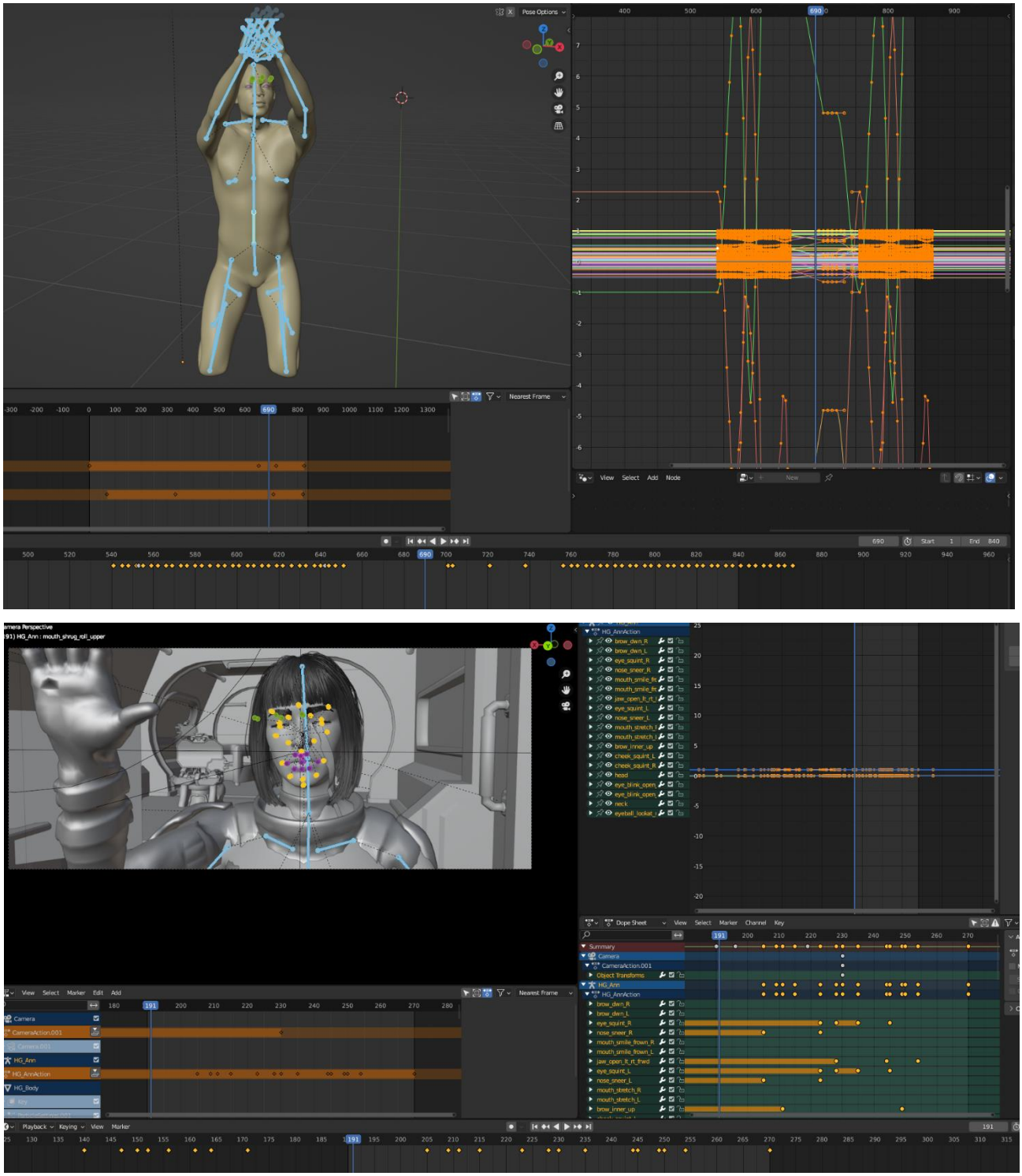


Figure 6.10: Frame by frame character animation

6.2.1.1 Camera shots and other animations

For a film, the camera movements and types of shot are very important. Most of the time I used dolly and pan shots. Top view and follow shots were also involved in some scene. Apart from camera animation, almost each scene has a good amount of other animation such as spaceship flying animation, objects moving animation, atmospheric animation and most importantly various types of effects and simulation which require animation works.

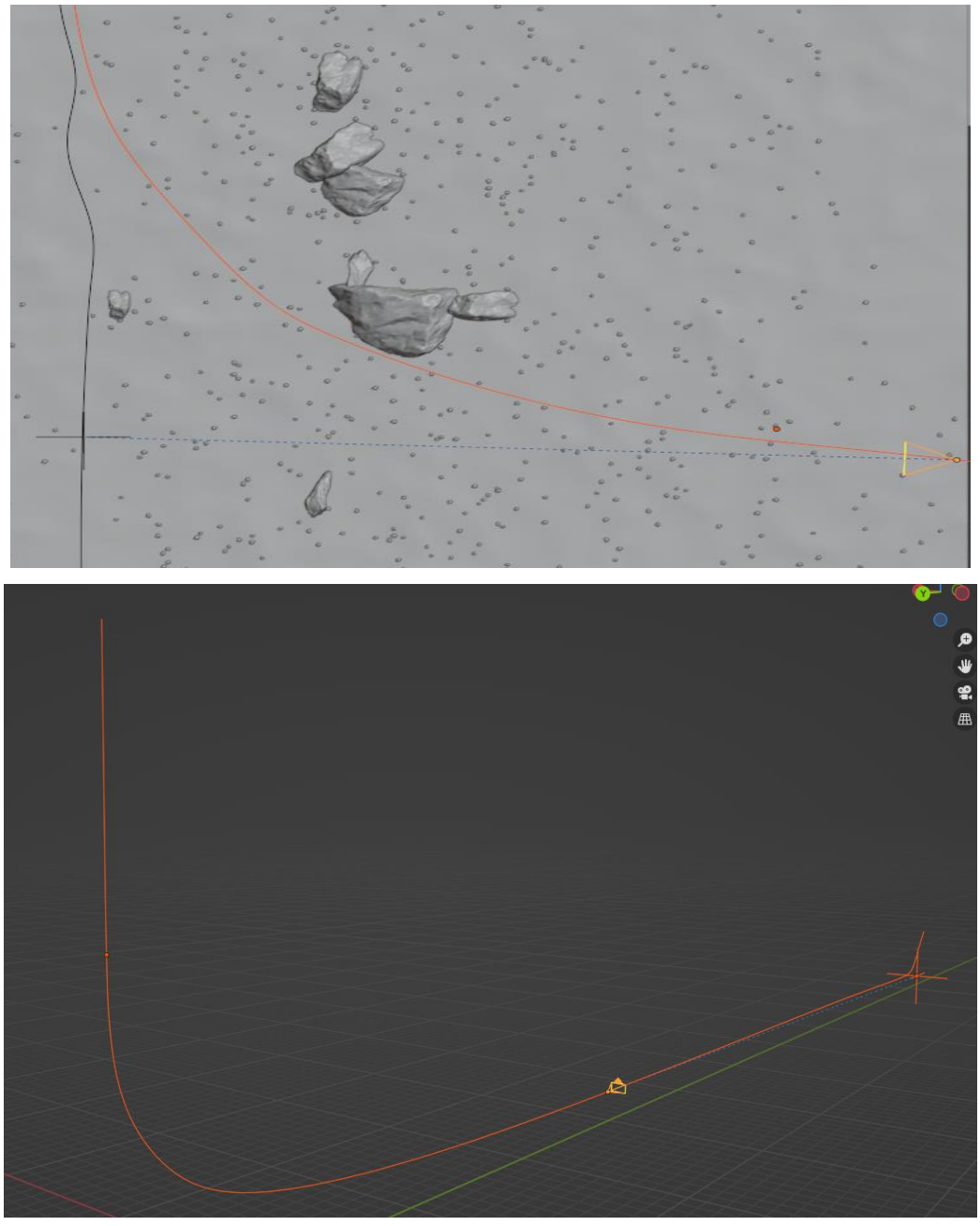


Figure 6.11: Camera animation using curved path

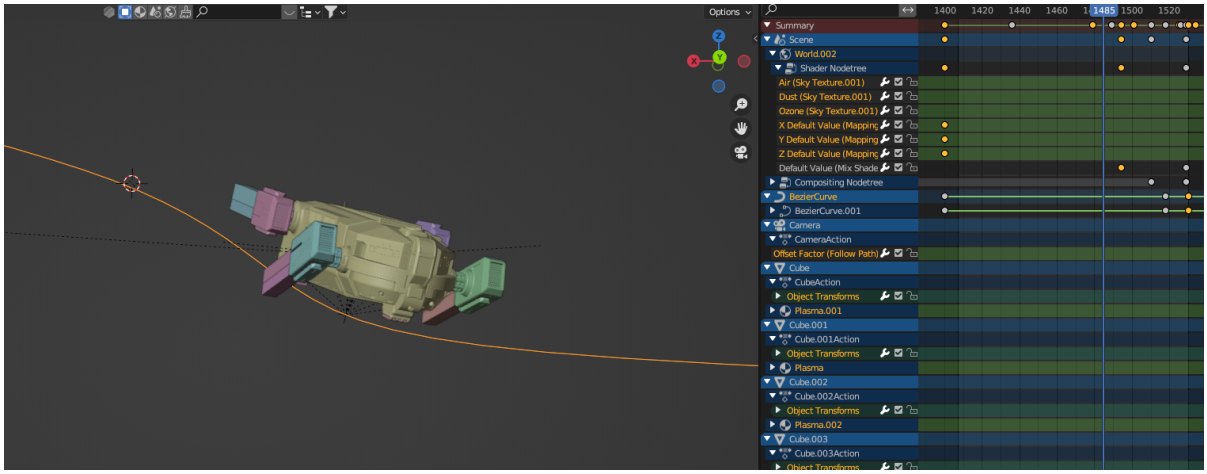


Figure 6.12: Spaceship animation using path and keyframing

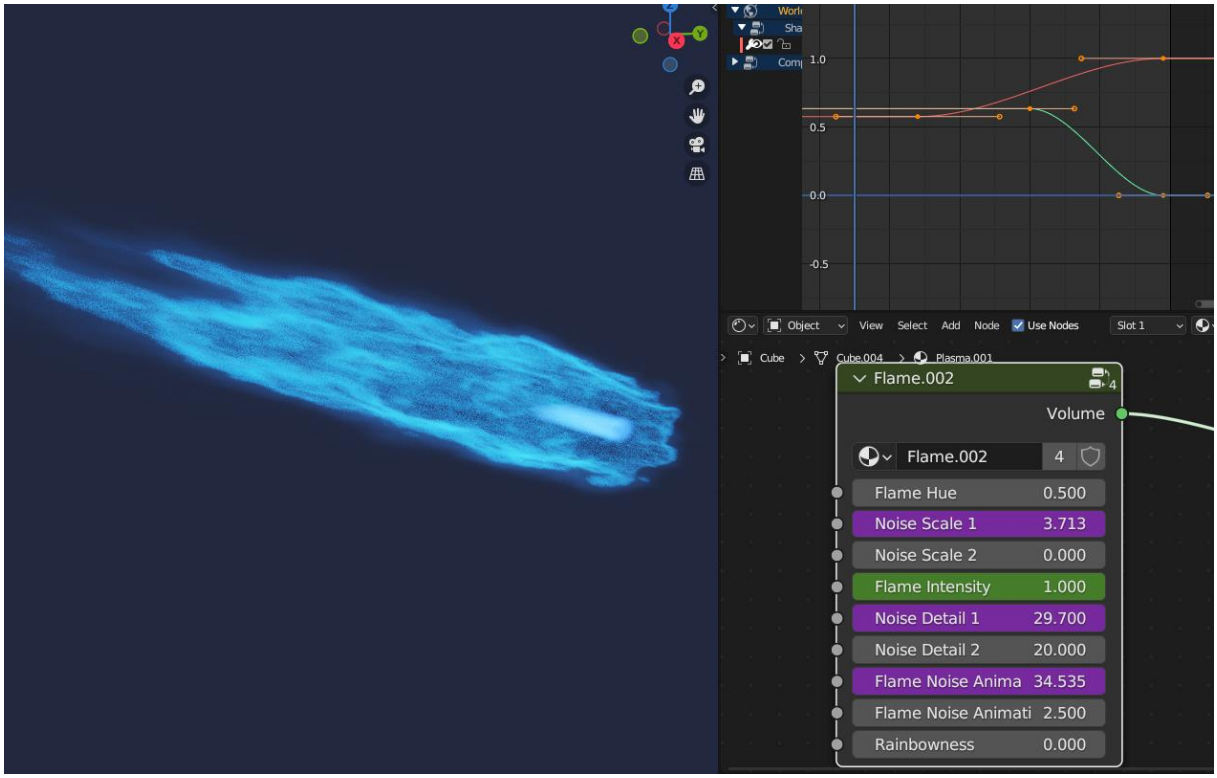


Figure 6.13: Ship booster animation using shader editor

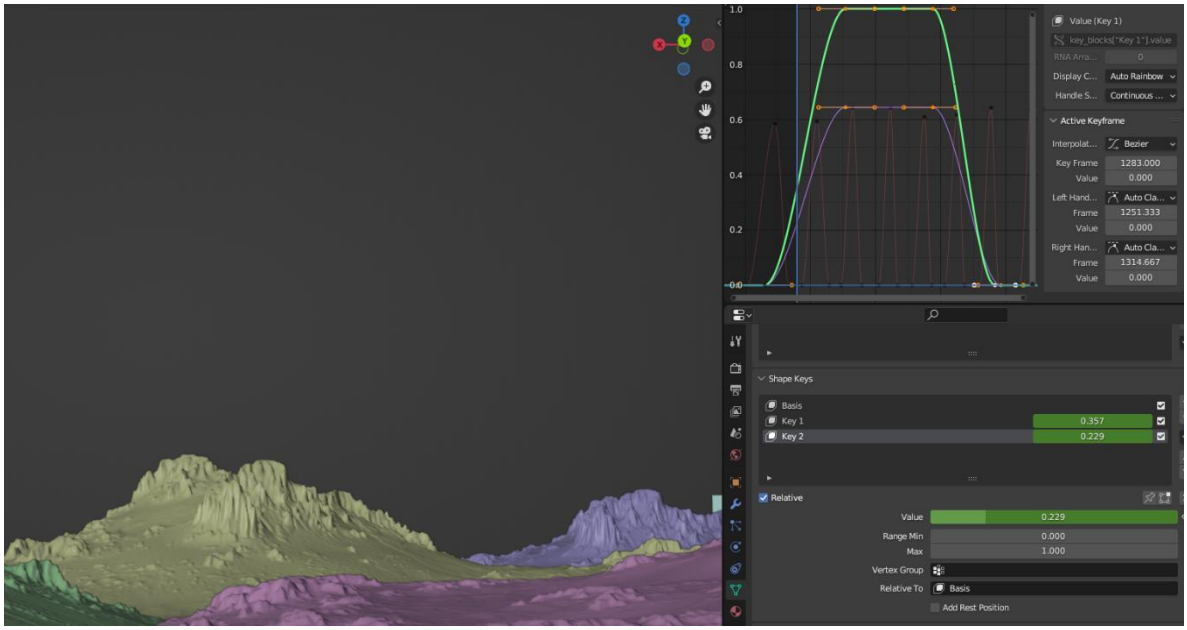


Figure 6.14: Mountain transformation animation using shape keys

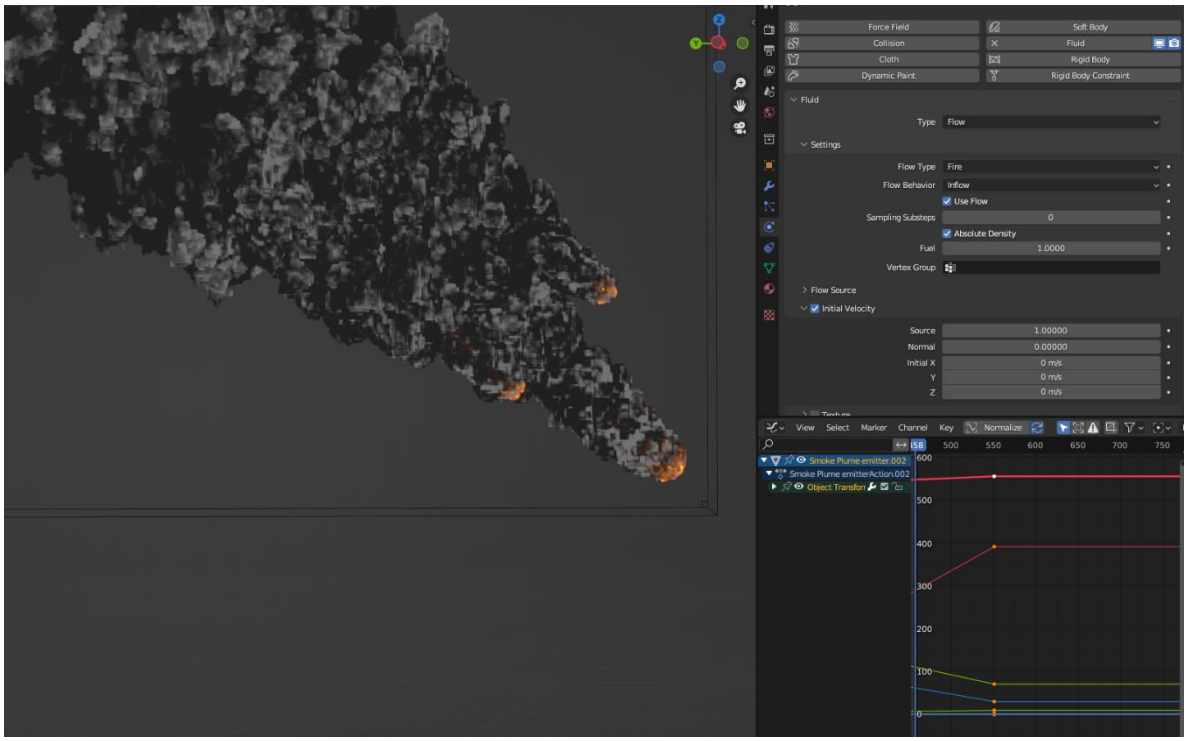


Figure 6.15: Meteor falling animation using fire simulation

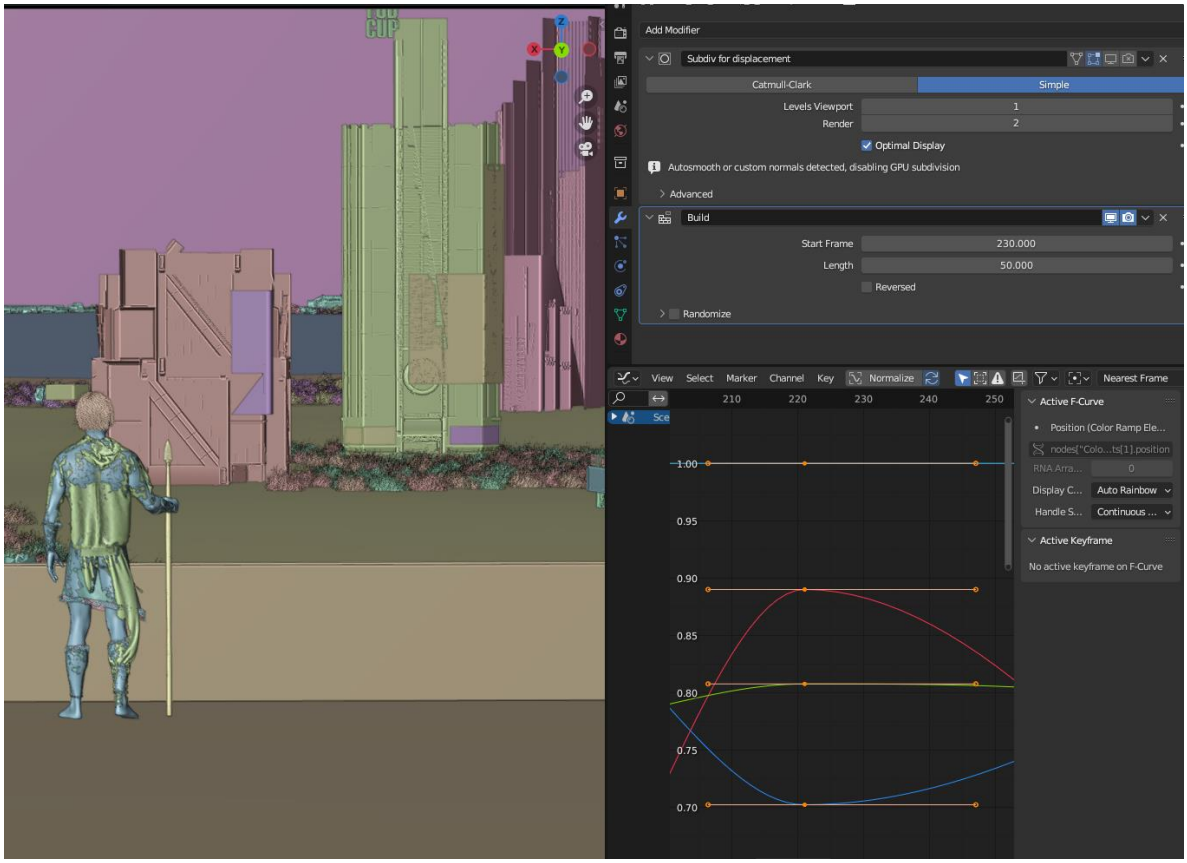


Figure 6.16: Building transformation using Build modifier

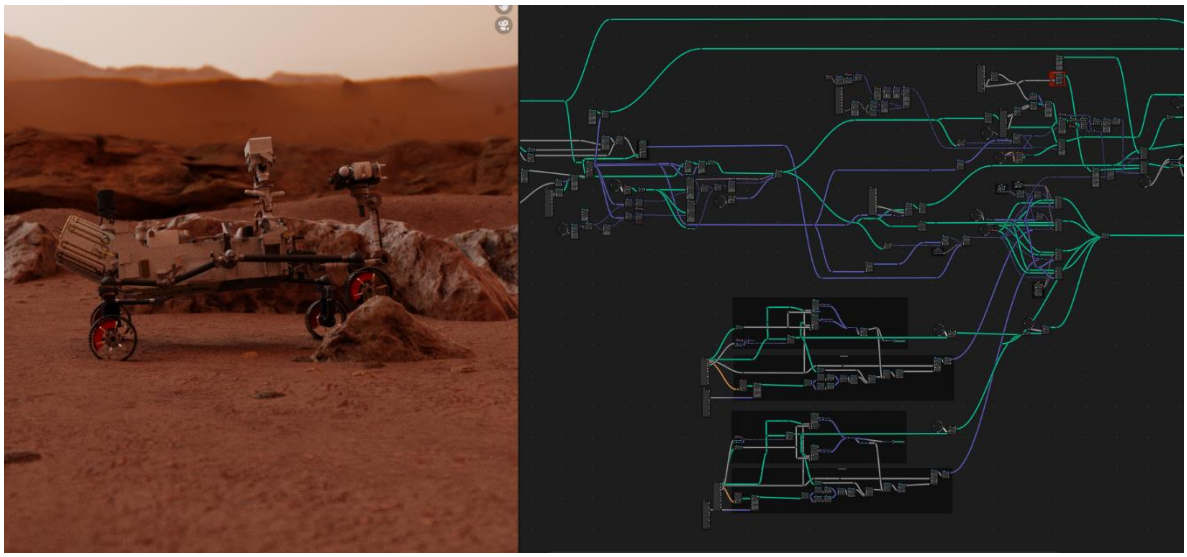


Figure 6.17: Rover rig and animation using geometry node

6.2.2 Cloth Simulation

For cloth simulation I used a different software called “Marvelous Designer”. This was important because at one scene I wanted to show wind blowing the cloths of the characters, also because of there was no cloth assets that could fit on the scenes.

Figure 6.18: Cloth simulation on Marvelous Designer

6.2.3 Texturing

Materials and textures are the essential components of every physical item. Textures and materials, from the softness of cashmere to the hardness of steel, give anything they are applied to a distinctive feel and appearance. Textures and materials can be blended to provide a lovely and distinctive look, whether the materials are smooth leather, gritty jute, or shiny metal. The appropriate blend of textures and materials can offer the ideal balance of strength and appearance, as different materials can offer varying degrees of flexibility, weather resistance, and longevity. In this case, I had to do a very good amount of texturing works. From the rock to the planets, everything was custom textured. And to do that I used Blender shading editor as well as Photoshop.

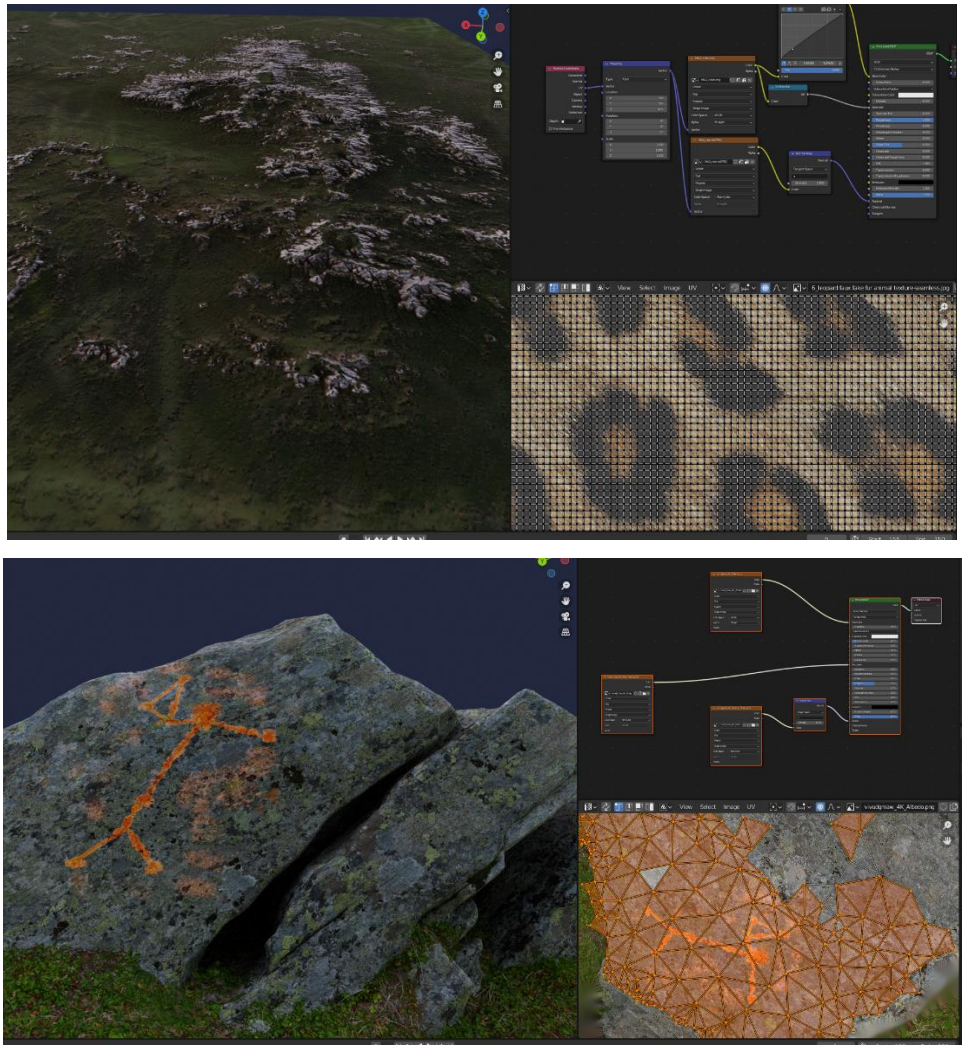


Figure 6.19: Texturing work on Hill and Rock

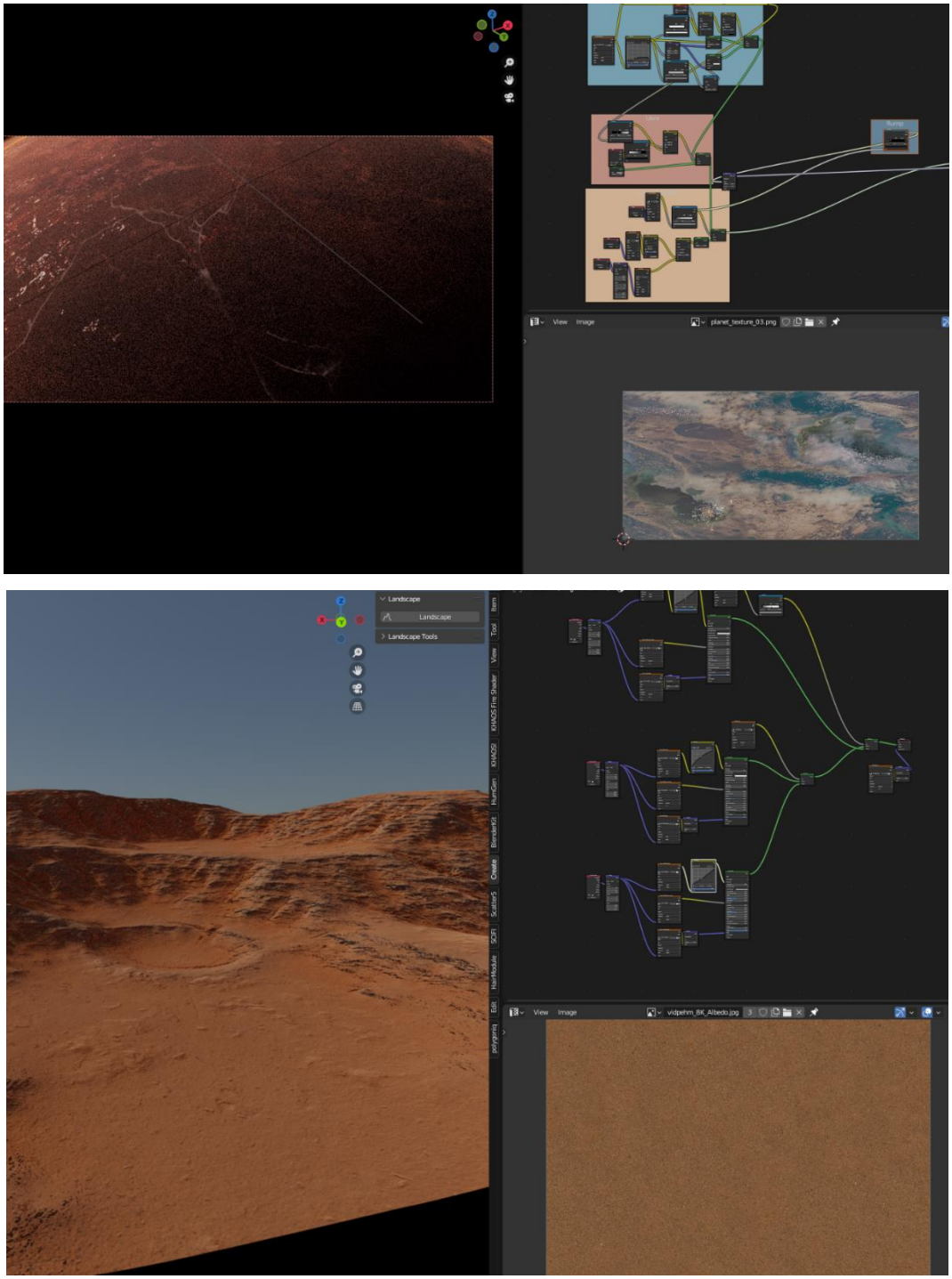


Figure 6.19: Texturing work planet and terrain

6.2.4 Rendering

For rendering I used Blender cycle render. The physically-based path tracer for production rendering in Blender is called Cycles. It is made with creative control and adaptable shading nodes for production needs in mind, and it is intended to deliver physically based results right out of the box. It also allows to use full power of a Graphics Card. I used a Nvidia 3090ti for fast rendering. And for better result I used the following settings.

Render Samples

Number of paths to trace for each pixel in the final render. As more samples are taken, the solution becomes less noisy and more accurate. For most the of the scenes, it was around 1000-2000.

Render Denoising

for the final render can be enabled or disabled with the checkbox. For denoising the image after rendering with the Denoising node, the Data Render Passes also adapt to the selected denoiser. In my work, I used optix denoiser. OptiX uses an artificial intelligence algorithm to remove noise from renders. It is based on the OptiX – NVIDIA acceleration engine and therefore has the same GPU requirements as rendering with Optix.

Light path Transparency

Increased light path transparency allowed to use images as plane. This helps to use many planes in a single location without any banding issue

Render Layers

For better composition, I rendered each scene in multiple render layer. In that way, I was able to tweak various part of a scene.

Output

For output, I used PNG format with RGBA color and 16bit of color depth.

CHAPTER 7
POST-PRODUCTION

So, for the post production work, I again went for blender in built composition panel. Same as other parts, Blender composition works on Node system and this is why its very easy to use. Some of the benefits of composition are Bright/Contrast node, Hue Saturation Value, RGB Curves, ColorRamp, separating parts of the image one from another, data passes, Glare node, Mix Node, Blur Node, Mask Node and many more.

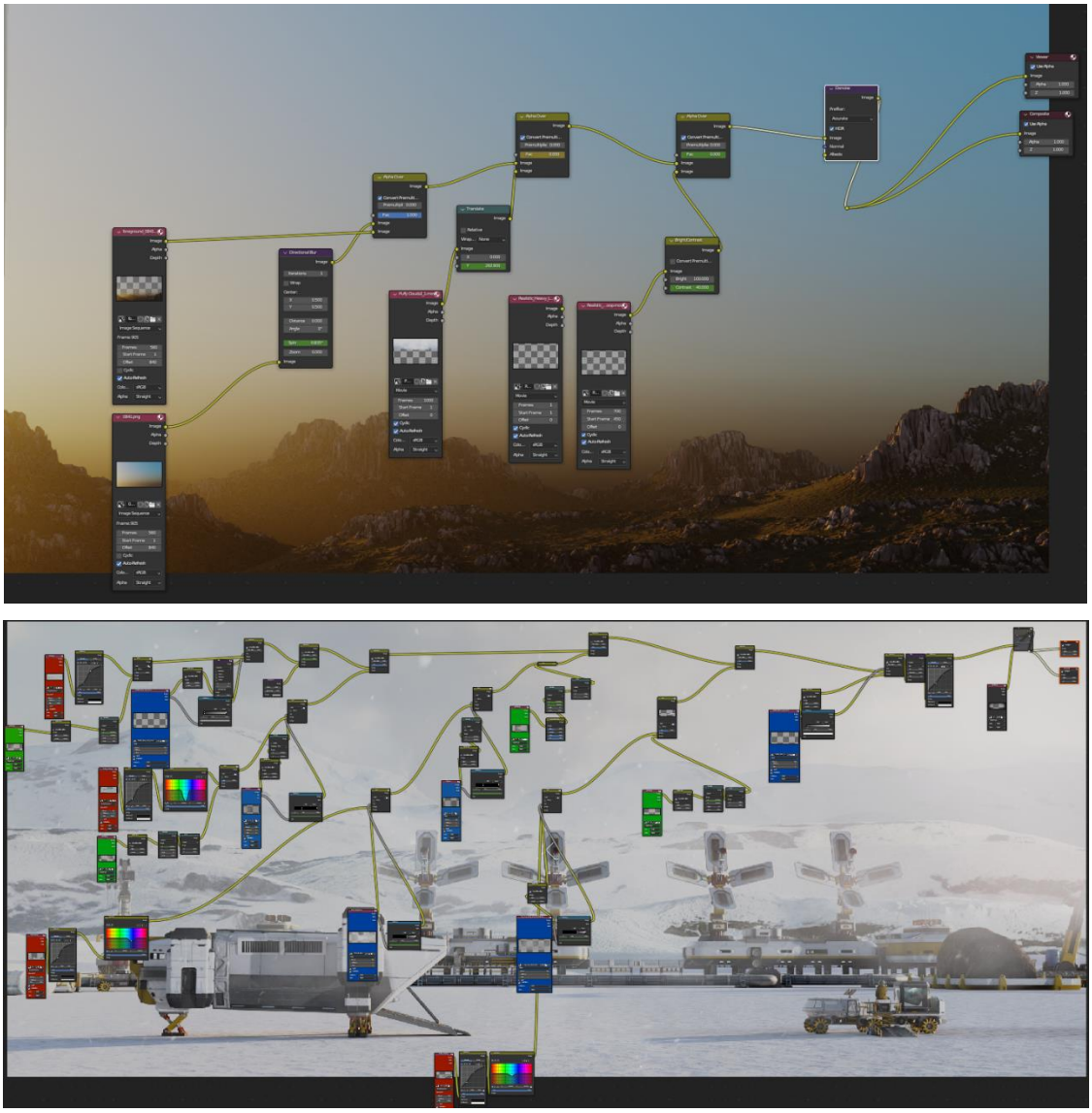


Figure 7.1: Composition in Blender

I used Adobe after effects for the tile reveal animation. Making the text from Adobe illustrator and then bringing it after effects was the main process. Then I animate each element frame by frame and completed the title animation.

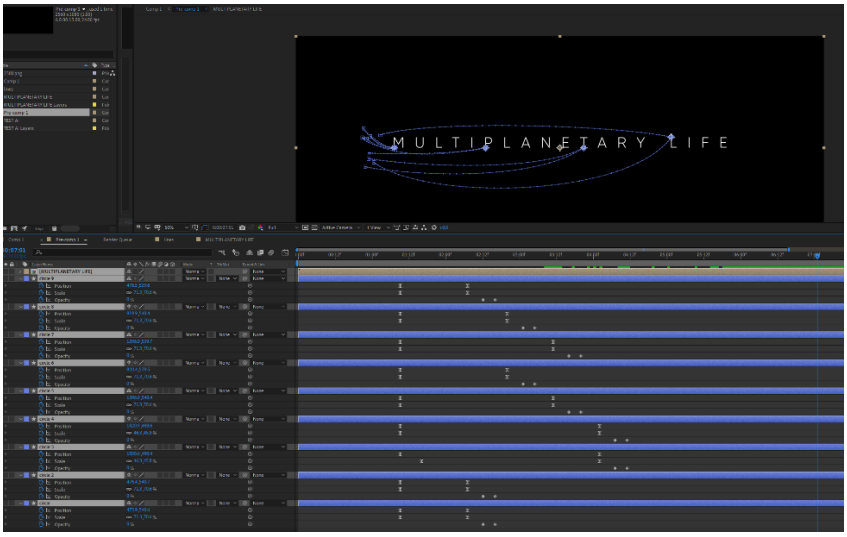


Figure 7.1: Title animation in After Effects

The post-production workflow of a video editor is the focus of Premiere Pro. For content producers and filmmakers to manage and edit video files as well as improve and fine-tune audio and image quality, it is supplied with a suite of potent editing tools.

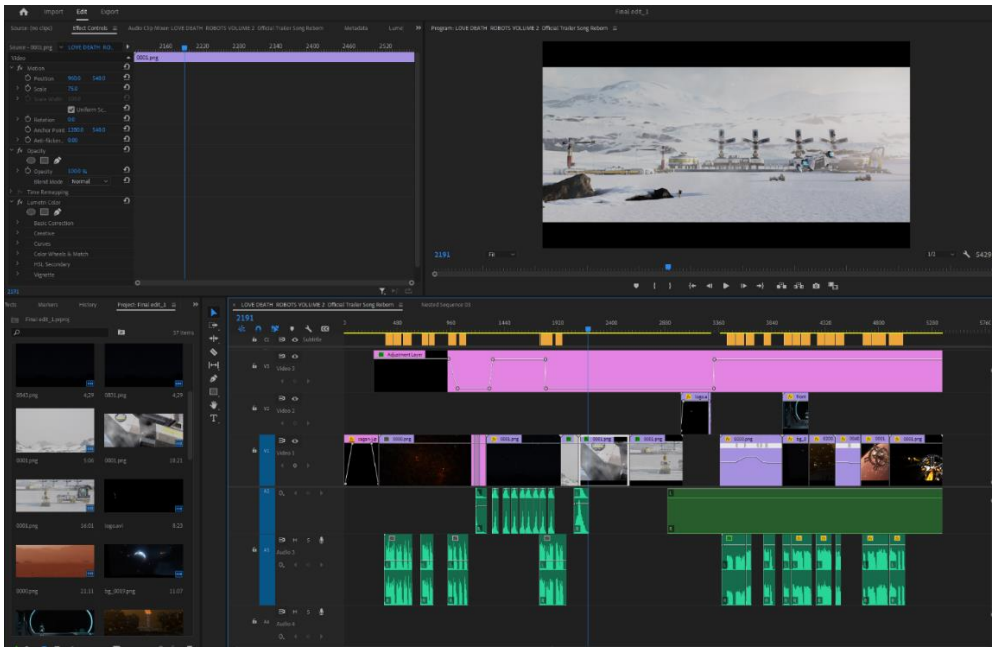


Figure 7.1: Final edit in Premiere Pro

CHAPTER 8
DISCUSSION

The short film takes the viewer on a journey that spans from the beginnings of human civilization to a future where humanity has successfully colonized Mars. By drawing parallels between our primitive past and the challenges of colonizing a new planet, the film highlights the incredible progress that humanity has made and the immense potential that lies ahead. Through the use of stunning visuals, the film captures the beauty and harshness of the Martian landscape, showcasing the engineering and technological achievements required to sustain human life in such a hostile environment. The narration by Carl Sagan, in his speech "A message to Mars," provides a powerful message of hope and inspiration, emphasizing the importance of scientific discovery and exploration to human progress. The film ultimately encourages viewers to embrace the spirit of exploration and the pursuit of knowledge, reminding us of the importance of looking to the future with a sense of optimism and possibility. By highlighting the incredible progress that humanity has made in the past and the potential for even greater achievements in the future, The short film serves as a powerful reminder of the strength and ingenuity of the human spirit.

The short film is reminiscent of Erik Wernquist's And many other science fiction works. Through stunning visual depictions of planets and moons in our solar system, the film takes the viewer on a journey of exploration and discovery, highlighting the immense potential for human space exploration and colonization. The use of CGI technology adds a unique and immersive dimension to the film, allowing for the creation of highly detailed and realistic environments that transport the viewer to distant worlds. The visuals are further complemented by the carefully selected and expertly crafted soundtrack, which enhances the emotional impact of the film.

CHAPTER 9
CONCLUSION

In conclusion, "Multiplanetary Life" is an impressive and inspiring work of CGI filmmaking. Through stunning visuals and the use of Carl Sagan's powerful message, the film takes the viewer on a journey from our primitive past to a hopeful and exciting future.

As a Bangladeshi CGI artist, this film can serve as an inspiration to push the boundaries of creativity and technological innovation to produce even better works of art. The production of this film has allowed me to develop essential skills in 3D modeling, animation, and visual effects, while also honing my own production pipeline. This process has given me the opportunity to refine my creative process and develop my artistic vision, pushing me to achieve new levels of technical and creative mastery.

The making of "Multiplanetary Life" has also been an enjoyable and fulfilling experience, allowing me to explore new frontiers in the world of CGI filmmaking while also contributing to the broader conversation around space exploration and the human desire for discovery and adventure.

In summary, "Multiplanetary Life" is a powerful and inspiring work of CGI filmmaking that serves as a testament to the incredible potential of human creativity and innovation. By pushing the boundaries of what is possible, you have demonstrated your ability to bring to life a vision of the future that is both beautiful and thought-provoking, and which will inspire future generations of artists, scientists, and explorers.

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HYPOTHESIS VISUALIZING THROUGH 3D ANIMATION, NARRATION, COMPOSITION FOR ANIMATED SHORT FILM- "MULTIPLANETARY LIFE" BY MD. ADNAN PARVEZ ID: 191-40-573 This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Multimedia and Creative Technology Supervised By Mr. Arif Ahmed Associate Professor Department of Multimedia and Creative Technology Daffodil International University DAFFODIL INTERNATIONAL UNIVERSITY DHAKA, BANGLADESH February, 2023 i APPROVAL This Project titled Story Hypothesis visualizing through 3d Animation, Narration, Composition for animated short film "Multiplanetary Life", submitted by MD. Adnan Parvez (ID: 191-40-573) to the Department of Multimedia and Creative Technology, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Multimedia and Creative Technology and approved as to its style and contents. The presentation has been held on February, 2023 BOARD OF EXAMINERS ii DECLARATION I hereby declare that; this project has been done by me under the supervision

of Mr. Arif Ahmed, Associate Professor, Department of MCT Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma. Supervised by: Mr. Arif Ahmed Associate Professor Department of Multimedia and Creative Technology Daffodil International University Submitted by: MD. Adnan Parvez ID: 191-40-573 Department of Multimedia and Creative Technology Daffodil International University iii ACKNOWLEDGEMENT First, I express my heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year project successfully. I am really grateful and wish our profound indebtedness to Mr. Arif Ahmed, Associate professor, Department of MCT Daffodil International University, Dhaka. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project. I would like to thank the entire faculty and the staff of MCT department of Daffodil International University, who took part in this discuss while completing the course work. Finally, I must acknowledge with due respect the constant support and patients of my parents and other family members. iv ABSTRACT Multiplanetary Life is an animated short film based on scientific hypothesis, The film is led by a narration which was narrated by American astronomer, planetary scientist, cosmologist, astrophysicist, astrobiologist, author, and science communicator CARL SEGAN. Throughout the whole film, A collection of many scenes can be seen, that represents many forms. Timelines and situation of human life. Such as, it shows how human species came from cave to today's world in a cinematic way. It also shows human evolution that could be done in near future which are possible if we go ahead with a certain inspiration, effort and encouragement. Such as human being multiplanetary life and living in Mars, Human harvesting energy from the sun using Dyson sphere thesis or may be human travelling in lightyear speed. A hypothesis states predictions about what research will find. It is a tentative answer to research questions that has not yet been tested. The purpose of this film is exactly the same. It represents visuals that may be occurred in future based on actual scientific research. It will be helpful and heartwarming content for people who are interested in space, human evolution and futuristic consequences. It also shows the actual visuals that scientifically correct but has not been seen yet. The making of the film took around five months to complete. All stages of production have been thoroughly supervised, including pre-production, production, and postproduction. It highlights several significant aspects of the project's development, including conducting research on a different planet, managing a large number of polygons, optimizing 3D environment scenes, maintaining a seamless look, using unusual camera angles and a camera rig, utilizing cloud rendering, creating a unique sound design, maximizing monitor resolution, managing the entire project with free tools, and Personal production pipeline creation that can be very much helpful for individual artists. v TABLE OF CONTENT CONTENTS PAGE APPROVAL ii DECLARATION iii ACKNOWLEDGEMENT iv ABSTRACT v CHAPTER CHAPTER 1: INTRODUCTION 1 1.1 Background 1 1.2 Motivation 2 CHAPTER 2: NARRATED AND ANIMATED FILM 5 2.1 Narrated film history 5 2.2 Narrated and animated film ideas 6 CHAPTER 3: CASE STUDY 9 3.1 Overview 9 3.2 Review of Related Literature 10 3.3 Theory on timeline of the short film 15 3.4 Objectives 17 CHAPTER 4: PRE-PRODUCTION 18 4.1 Story 18 4.1.1 (Scene1) Savannah 19 4.1.2 (Scene2) Sky Transition 19 4.1.3 (Scene3) Polar Present 19 vi 4.1.4 (Scene4) Mars 4.1.5 (Scene5) Multiplanetary Human 4.1.6 (Scene6) Doomsday 4.1.7 (Scene7) Home Sweet Home 4.1.8 (Scene8) Development on Mars 4.1.9 (Scene9) To the other sides 4.2 Script 4.3 Reference for scenes 4.4 Audio work for narration CHAPTER 5: RESEARCH ON EACH SCENE 5.1 Savannah 5.2 Sky Transition 5.3 Polar Present 5.4 Mars CHAPTER 6: PRODUCTION 6.1 Asset Production 6.1.1 Characters 6.1.2 Props 6.1.3 Environment Asset library 6.2 Shot Production 6.2.1 Animation 6.2.1.1 Character animation 6.2.1.1 Camera shots and other animations 6.2.2 Cloth Simulation 20 20 20 21 21 21 22 27 30 32 32 34 35 35 37 37 37 40 41 46 46 46 48 52 vii 6.2.3 Texturing 6.2.4 Rendering CHAPTER 7: POST-PRODUCTION CHAPTER 8: DISCUSSION CHAPTER 9: CONCLUSION REFERENCES 53 55 56 58 59 60 viii LIST OF FIGURES FIGURES PAGE NO Figure 1.1: Real black hole and black hole from Interstellar 2 Figure 1.2: Goerges Melies moon landing and real moon landing 3 Figure 1.3: Erik Wernquist's Hypothesis short films 4 Figure 2.1: The great train robbery (1903) 5 Figure 2.2: Shawshank Redemption (1994) 6 Figure 2.3: Fight Club (1999) 7 Figure 2.4: The Book Thief (2013) Figure 2.5: The Grinch (2018) 7 8 Figure 2.6: It's such a beautiful day (2012) 8 Figure 3.1: Hypothesis Structure Figure 3.2: Michio Kaku and Carl Sagan's books Figure 3.3: Michio kaku, Nicholas Rescher and James Braha's books 9 11 12 Figure 3.4: Erik Wernquist CGI works 13 Figure 3.5: Three types of Kardeshev civilizations 16 Figure 4.1: Script page (1) 22 Figure 4.2: Script page (2) 23 Figure 4.3: Script page (3) 24 Figure 4.4: Script page (4) 25 Figure 4.5: Script page (5) Figure 4.6: References for scene Savannah 26 27 Figure 4.7: References for scene Polar Present 27 ix Figure 4.8: References for scene Doomsday Figure 4.9: References for scene Home sweet Home Figure 4.10: References for scene Mars Figure 4.11: Audio book "Pale Blue Dot" Figure 4.12: Epubor audio book converter Figure 4.13: Adobe Audition Sound mixing Figure 5.1: Sirius Star Figure 5.2: Sirius Star Earlymen Drawing Figure 5.3: Blender sun position drive Figure 6.1: Characters made in human gen Figure 6.2: Mixture of Sketchfab and Human gen characters Figure 6.3:

Characters from Ian Hubert Patreon page Figure 6.4: Props for characters Figure 6.5: Vegetation assets created in Blender Figure 6.6: Terrain assets created in World creator Figure 6.7: Planets created in Blender Figure 6.8: Tree assets from Botaniq addon Figure 6.9: Patreon assets scattred by geometry nodes Figure 6.10: Paid and free assets from Kitbash3d Figure 6.11: Frame by frame character animation Figure 6.12: Camera animation using curved path Figure 6.13: Spaceship animation using path and keyframing Figure 6.14: Ship booster animation using shader editor Figure 6.15: Mountain transformation animation using shape keys 28 29 29 30 30 31 33 33 34 38 39 39 40 41 42 43 44 44 45 47 48 49 49 50 x Figure 6.16: Meteor falling animation using fire simulation Figure 6.17: Building transformation using build modifier Figure 6.18: Rover rig and animation using geometry node Figure 6.19: Cloth simulation on Marvelous Designer Figure 6.20: Texturing work on hill and rock Figure 6.21: Texturing work on planet and terrain Figure 7.1: Composition in Blender Figure 7.2: Title animation in after effects Figure 7.3: Final edit in premiere pro 50 51 51 52 53 54 56 57 57 xi CHAPTER 1 INTRODUCTION 1.1 Background A research hypothesis is a statement of expectation or prediction that will be tested by researches. Which we always see in movies and documentaries. A Hypothesis can be just a prediction but most of the time, because of vast numbers of researches, it can occur as a reality. We have been experiencing this for a very long time. As an example, in the movie "2001; A space odyssey", director Stanley kubrik showed people in space. People travelling through different planets and living in space ship. This was in 1968. And one year later man landed on the moon for real. Many elements that are showed in many science fiction movies are happening in real life right now. And even we take something outside science fiction, in the movie "Contagion (2011)" we see a huge pandemic that happens and how people go through that, this happened exactly in a same way by the corona pandemic. Hypothesis is not just a thesis because there are a lot of researches get involved in that. And the predictions from that are not just fantasy. Multiplanetary Life is something like that, based on hypothesis that have been continuously researched in NASA, Space X, and other planetary research organizations, this film represents human evolution, the exploring system built into us by natural process that doesn't allow us to stay in one place and how it can take us to other planets. This film was inspired by many books by many scientists, especially the book called "Pale Blue Dot" by Carl Segan. In face a narrative was used in the film to give the vibe of seriousness of these hypotheses. The narrator is Carl Segan himself. Some portion of the audio version of the book was taken, and some audios from his many interviews was mixed together. 1.2 Motivation Motivation for this film was literally every single CG work that involved hypothesis in some way. There are a lot of movies, series and documentaries where the power of beautiful concepts based on real life research were shown perfectly. If we talk about example, a film by Christopher Nolan can be brought in front. "Interstellar" is movie where the director hired scientist to do research so that the concepts and visuals represent the actual version of every element in the movie. Such as the black. In the movie they showed a black that was created using mathematical equation of physics and with the help of hypothesis that was done before that. At the end they made a beautiful visual of a black hole. But years after that, when scientist took the first photo of an actual black hole, they realized it looked almost the same as the one Christopher Nolan featured in his movie. This is why its so important to visualize imagination with a good amount of actual research and this prove the point of immense possibilities of the hypothesis on human evolution. Figure 1.1: Real black hole and black hole from Interstellar The very first sci-fi movie mankind ever created was called "A Trip to the Moon" by Georges Méliès in 1902 based on Jules Verne's novels "From the Earth to the Moon and Round the Moon". Years later human stepped on the moon's surface. Figure 1.2: Goerges Melies moon landing and real moon landing This Short film is mainly inspired by work of an individual artist named "Erik Wernquist" who have been working on visualizing thesis of NASA, Space-x and other scientist's personal work / presentations. There was a documentary based on a book (1976) by American physicist Gerard K. O'Neill. He explained in his book about how human community can live in space inside a giant and massive cylinder. Erik wernquist made a beautiful narrative short film on this and on many other topics, that motivate me more on this hypothesis imagination world. Figure 1.8: Erik Wernquist's Hypothesis short films CHAPTER 2 NARRATED AND ANIMATED FILM 2.1 Narrated film history Any movie that tells a fictional story set in a particular setting and period of time is considered a narrative film. It frequently progresses through conflict or a challenge the main character(s) faces. Similar to recounting a narrative to a buddy, but with considerably more depth and purpose, the events show on the screen in some form of succession. Usually, a narrative film carries a voice behind the visual to narrate everything in a poetic way. Why do films use narrative? Here are some of the causes: • to impart knowledge and to present a vision • to show idea in a compelling way in order to make the film's message approachable • People will always be able to understand and enjoy stories that are well-told and contain genuine settings and scenarios. • to share a vision or idea in a captivating form • sometimes it's just better aesthetic to have a beautiful voice in films It is widely believed that Porter's The Great Train Robbery (1903) was the first narrative movie to accomplish such action continuity. [1] Figure 2.1: The great train robbery (1903) 2.2 Narrated and animated film ideas Let's define animation in terms of how it relates to narrative. According to Pikkov

and Näripea (2010) on page 15, the Latin word "anima" implies "the breath of life," "vital principle," or "soul." Animation is a presentation of still pictures that are put together and projected for the audiences, according to Ülo Pikkov in a study about Animasophy. He presented two contrasts between animation and live-action cinema and between animation and puppet show. Although all three of the aforementioned types have story, they are distinct from one another. Marionettes move in real life, whereas viewers of animation are shown movement that occurs not on the screen but rather in the viewers' minds. Despite the fact that a live-action film also includes a number of still images One of the key components of animation is narrative, which sets animated films apart from other types of animation. The essential function of the "film" component of "animated film," which is to tell a story framework, is satisfied by narrative. Some good narrated movie and documentaries: [3] Figure 2.2: Shawshank Redemption (1994) Figure 2.3: Fight Club (1999) Figure 2.4: The Book Thief (2013) Figure 2.5: The Grinch (2018) Figure 2.6: It's such a beautiful day (2012) CHAPTER 3 CASE STUDY 3.1 Overview A movie or documentary or series that has any kind of research or hypothesis in it, has to go through a bunch of reference, research papers or examination in order to get a perfect logical sense. My work on this short film is not outside of that area. Since there are a lot of references of hypothesis, I had to go through many books, papers, movies and other references that I could find. Science fiction books and films are full of futuristic concepts, but they typically use them to set up an exciting adventure rather than as a serious attempt to forecast future developments in science or technology. According to the rules of physics as we currently understand them, some of the most popular tropes—like accelerating a spacecraft to amazing speeds in a matter of seconds without crushing the occupants—are just not possible. However, the same laws seem to allow for other seemingly fantastical sci-fi ideas, such as wormholes and parallel universes. Science fiction is a well-known genre that amplifies elements of actual science to create fictitious works. As an illustration, after watching interstellar, Michio Kaku (American theoretical physicist, futurist, and popularizer of science) said: "Just saw Interstellar. Great movie. Highly recommended. They only broke a few laws of physics. (They even have some string equations.)" Figure 3.1: Hypothesis Structure 3.2 Review of Related Literature Science fiction authors occasionally have the power to imagine the future. For instance, Mary Shelley investigated the concept of reanimating bodies before the defibrillator was created. Before the technology even existed, Jules Verne envisioned going into space. When the Sleeper Wakes was published in 1910 by author H.G. Wells. He recalls how two men passed through what appeared to be a solid wall. The wall "rolled up with a snap" to allow entry as they got closer before closing once more. And then Automatic doors that opened on either side of an entranceway were created in 1954 by Dee Horton and Lew Hewitt. A handheld communication device was envisioned in Star Trek. The device was referred to as a "communicator" and had the capacity to communicate over impossibly large distances, allowing Captain Kirk to get in touch with the Enterprise that is now in orbit while he is stranded kilometers below the surface of a planet. Martin Cooper, who was in charge of Motorola's communications systems group at the time, was motivated by it to create the mobile phone. An interactive digital environment was first shown in the 1982 movie Tron. Neal Stephenson published Snow Crash, a book on virtual reality, in 1992. It is strikingly similar to modern virtual reality. Currently, parallel worlds can be experienced with googles, haptic gloves, and metaverse. Soon, perhaps even taste and smell will be a part of the total experience. Isaac Asimov made predictions about the state of the world in 50 years in a piece he wrote for the New York Times in 1964. One of his many, uncannily correct forecasts was the creation of a car with a "robot-brain.". K.I.T.T. from the 1982 television series Knight Rider is among the most well-known instances. Even James Bond frequently droves vehicles with driverless features. Today we have fully automatic self-driven car such as Tesla. Numerous additional manufacturers and tech firms are vying to develop completely autonomous vehicles. [4] These are some basic examples of how a hypothesis or prediction can come true in near future. All the advanced technology we are using right now were some kinds of theory back in times. So why won't we say that the predictions and theory experts, scientists are giving today will come true someday? This is exactly why, I have gone through a tone of books, papers and movies to get some idea about what might happen in our near future. Figure 3.2: Michio Kaku and Carl Sagan's books Figure 3.3: Michio kaku, Nicholas Rescher and James Braha's books Erik Wernquist, a Swedish character animator, writer and director inspired me the most through his work for making this short film for my final project. Erik Wernquist has been making CGI shorts on theory and hypothesis since 2013 or around that time. Some of his works that inspired me are Wanderers (2014), A Warm Place (2018), Opening sequence of The High Frontier (2021), Go Incredibly Fast (2022) Figure 3.4: Erik Wernquist CGI works Some movie list that I have seen and inspired me: • 2001: A Space Odyssey (1969) • Andromeda Strain (1971) • Contact (1997) • Deep Impact (1998) • Minority Report (2002) • Wall-E (2008) • Her (2013) • Interstellar (2014) • The Martian (2015) • Arrival (2016) • Rick and Morty • A Trip to the Moon (1902) • A.I. Artificial Intelligence (2001) • District 9 (2009) • High Life (2019) • Edge of Tomorrow (2014) • Star Trek (2009) • Annihilation (2018) • Primer (2004) • Blade Runner 2049 (2017) • Ex Machina (2015) • The Fifth Element (1997) • Akira (1988) • The Terminator (1984) • Back to the Future (1985) • Back to the Future, Part II

(1989) • The Matrix (1999) • Star Wars Episode V: The Empire Strikes Back (1980) 3.3 Theory on timeline of the short film In 1963, the Russian astrophysicist Nikolai S. Kardashev came up with a hypothetical way to understand just where exactly we fit in. He developed what is now referred to as the Kardashev Scale, a system for gauging a civilization's technical prowess based on the quantity of energy it is able to harness. Kardashev created a three-level scale based on the quantity of energy a civilization could harness to describe the possible level of its development. On this scale were: 1. A Type 1 civilization, also referred to as the planetary civilization, is able to use all of the energy available on its home planet, including all solar energy and all of the energy it can generate (thermal, hydro, wind, etc.). It had "technical level close to the one currently obtained on the Earth," according to Kardashev. A global civilization, according to physicist Michio Kaku, should be able to manage things like earthquakes, the weather, and volcanoes and would be developing ocean cities. In that scenario, we still have a way to go. According to Kaku, it will take another 100– 200 years for us to reach Type 1 level. According to Carl Sagan, we are currently only 0.7 steps away from type 1 space. 2. Once we reach Type 1, we'll probably depart Earth in search of energy sources on other worlds. We would advance to type 2 civilization if we were able to establish an extraterrestrial civilization that could utilize a star's whole energy potential. One way to do that is by building a Dyson Sphere-style megastructure around a star is one approach to use its energy. It would be able to completely envelop a star, absorb all of its energy, and then transmit the energy to the planet's surface for consumption. 3. A type 3 civilization is of an entirely different evolutionary order and takes possibly 100,000 years or more to reach. According to Kardashev, it would be "a civilization with energy on the scale of its own galaxy." Yes, in order to get this advanced, you must obtain the energy of an entire galaxy. By then, humans would have likely evolved into some type of post-biological cybernetic being by that time. [5] From the theory and discussion from above, we can see that a type 3 or 2 civilization is far more away than we can imagine. And probably they sound like fairy tale in today's time. But we are going there at some degree. We already managed to make reusable rockets and probably we will be a multiplanetary species in near future. That will include us as a type 1 civilization. My short film takes place in that timeline. I wanted to show which is more sensible in today's time and with the knowledge we have right now. And may be there will be a time soon, where human would be doing such things as shown in the short film. Figure 3.5: Three types of Kardeshev civilizations 3.4 Objectives Objectives of making this short film can be viewed in many ways. In the making of the film, these are some of objectives that I hoped to achieve: • To make a good quality animated short that can be placed among other work in the industry • To understand animation workflow • To understand high quality rig with IK system • To Make good quality simulation works • To work on rendering process that is one of the most powerful segments • Developing a personal production pipeline that can help individual artists • And most importantly, making a short film that is based on theory and hypothesis • To make a narrated film using the great carl Sagan's voice In the sense of making an impact on the audience of this film, these are some of the objectives: Encouraging people to wonder about the beautiful future that we can have • • To make people more interested in space science and cosmos To make a good visualization for the people who are interested in or studying on human development that can be occurred in future • • To trigger interest to dig deeper and learn more about hypothesis on human evolution to show a glimpse of the fantastic and beautiful nature that surrounds us on our neighboring worlds - and above all, without any apparent story, other than what audience may fill in by themselves CHAPTER 4 PRE-PRODUCTION I adhered to an industry-standard production line to ensure Multiplanetary life's maximal output in order to secure the long-term viability. 4.1 Story The story is based on the hypothesis idea of evolution of human being colonizing on other planets to not get cease to exist. My target was to make this on actual thesis based on Nasa, Space X and other planetary research organizations. And to give that original vibe, I wanted to add a narrative to the film. And what's better than using an actual scientist's narration? I researched on the narrative and found the beautiful narration done by Carl Sagan (astronomer, planetary scientist, cosmologist, astrophysicist, astrobiologist, author) which is called "a message to mars". The story will first show the human evolution from being early men in cave to modern men in this new generation. To give an idea how human always been explorers. And then it will show how we can be colonized in mars or other planets. The scenes will be visualized in a way that it will do justice to the overall film idea and the narration. I also added some line form Carl Sagan's audio book "Pale blue Dot" Here is the transcript of the narration that was put together for the short film. "For 99.9 percent of the time since our species came to be, we were hunters and foragers, wanderers on the savannahs and the steppes. We were bounded only by the Earth and the ocean and the sky. In the last ten thousand years an instant in our long history we've abandoned the nomadic life. Science and science fiction have done a kind of dance over the last century, particularly with respect to Mars. I don't know why you're on Mars. maybe we're on Mars because we recognize that if there are human communities on many worlds, the chances of us being rendered extinct by some catastrophe on one world is much less. maybe we're on Mars because of the magnificent science that can be done there - the gates of the wonder world are opening in our time. Maybe we're on Mars because we have to be, because

there's a deep nomadic impulse built into us by the evolutionary process, we come after all, from hunter gatherers, and for 99.9% of our tenure on Earth we've been wanderers. And, the next place to wander to, is Mars." The story goes with this transcript to show the visual of the imagination that Carl Sagan referring here. This show the very beginning of us being as a multiplanetary species. All the stories for each scene are given below: 4.1.1 (Scene1) Savannah Some people from early age which around 10,000BC are going to a specific shrine place, where they pray to stars. These people from early age thinks stars are God since they do not know anything better. They lit the area using fire and pray to stars, specially the "Sirius Star" for better weather, food availability and Survival chance. Narration: "For 99.9 percent of the time since our species came to be, we were hunters and foragers, wanderers on the savannahs and the steppes. We were bounded only by the Earth and the ocean and the sky." 4.1.2 (Scene2) Sky Transition The sky is moving and showing timelapse of days and night. Years have passed and now we are in 2030. A high-tech Cargo flying Ship is coming from that exact sky after the Centuries Transition. Narration: "In the last ten thousand years an instant in our long history we've abandoned the nomadic life" 4.1.3 (Scene3) Polar Present Some modern-day scientists are running an expedition in the exact same place where early men were used live and pray. These scientists wear astronomer suits because earth is almost too toxic right now to live and breath casually. They somehow find some evidence of early men praying to the stars. No Narration 4.1.4 (Scene4) Mars One of the mars rovers that NASA sent to mars, wanders on mars surface. It runs on a higher surface of mars and then stopes at edge of the cliff. Mars has already been colonized. Narration: "Science and science fiction have done a kind of dance over the last century, particularly with respect to Mars. I don't know why you're on Mars." 4.1.5 (Scene5) Multiplanetary Human People has reached to a point that now they live in mars and probably going to live in other planets. An astronaut watching earth being destroyed by an asteroid that is heading towards earth from a spaceship hangar. Narration: "Maybe we're on Mars because we recognize that if there are human communities on many worlds," 4.1.6 (Scene6) Doomsday For many reasons, there are a lot of people left in earth. Maybe they are poor to go to mars. Maybe they chose to stay in earth which they believe is the only home and its beautiful. Or may be some of them are protestors who were not in the support of human being multiplanetary and spending immense amount of money on it where they had a lot of problems in earth itself. They built Aftermath organizations to maintain whatever is left on earth. Unfortunately, this is the day its all going to go. And they understand that they have nothing to do about it except embrace the reality and their future. Narration: "The chances of us being rendered extinct by some catastrophe on one world is much less." 4.1.7 (Scene7) Home Sweet Home Watching the place which has been the sweetest home of us for around 2.5mllion years, The astronaut feels pain and sadness. No Narration 4.1.8 (Scene8) Development on Mars Mars has been developed as a fully sustainable planet for live in and maintain the legacy of human life. People now do science experience and invention on mars. There are space station and scientific development on mars just like it was once on earth. But now they are more organized and planned for future. Narration: "Maybe we're on Mars because of the magnificent science that can be done there," 4.1.9 (Scene9) To the other sides A spaceship that is big enough to hold good amount people, enough for starting a new colonization going through a wormhole that is discovered by advanced human living in mars. They hope to find another galaxy on the other side with planets that is similar to earth. Narration: "The gates of the wonder world are opening in our time." 4.2 Script The script was written in industry level format using Courier font, 12-point size, single spaced. This is to gain knowledge on how filmmakers or writers deal with a script. Figure 4.1: Script page (1) Figure 4.2: Script page (2) Figure 4.3: Script page (3) Figure 4.4: Script page (4) Figure 4.5: Script (5) 4.3 Reference for scenes Figure 4.6: References for scene Savannah Figure 4.7: References for scene Polar Present Figure 4.8: References for scene Doomsday Figure 4.9: References for scene Home sweet Home Figure 4.10: References for scene mars 4.4 Audio work for narration For the first portion of the narration. I had to buy and download an audio book of Carl Sagan called "Pale blue dot". The audio was not in mp3 format because the website called audible provides the audios in an encrypted format. I had to decrypt it in order to get the first portion of the narration. To do that, I used a software called "Epubor". It simply adds any audio book and can convert them into mp3. It can also split the audios in chapters. Figure 4.11: Audio book "Pale Blue Dot" Figure 4.12: Epubor audio book converter It was kind of hard work to make the audio from "A message to mars" which is a big portion of the narration. It was recorded with old technology and it had a lot of sound from the nearest waterfall. For the short film, the narration has to be crystal clear. That's why I used adobe audition to clear out all the noise and other things, and make the more vibrant. Figure 4.13: Adobe Audition Sound mixing Many equalizers available in Adobe Audition to see which ones is more preferable to use to cut down on background noise. One octave, one-half octave, and one-third octave equalization settings are available in Audition. Figure 4.14: Adobe Audition Equalizer CHAPTER 5 RESEARCH ON EACH SCENE Because the entire short film is based on hypothesis and practical theory we have now. I had to do a good number of researches on each scene to make it more genuine and logical. All the researches are on each scene are described below: 5.1 Savannah The idea of this scene showing early men came to my mind

sometimes ago. But which location I should show came to me from research called "Introduction to Human Evolution" by Smithsonian national museum of Natural history. It says that very early men used live in Africa, especially the places called "Savannah". This is why I tried to make an environment that is much similar to savannah. [6] From research called "The ancient wonder and veneration of the dog star Sirius", I got to know that early men and ancient people used to worship a star called "Sirius". All throughout human history, ancient peoples have marveled at and revered Sirius, the brightest star in our sky. Since Sirius is prominent in the constellation Canis Major, it is frequently referred to as the "Dog Star" (Greater Dog). Strangely, the blazing Sirius has always been identified with either a wolf or a dog by ancient civilizations with no apparent relationship. They used to worship this star for greater life style, good environment, rain and food. Early men used to think stars are God. This is one them. From here I took the idea and put the star in the scene, where the early men worship the pattern of the star. Figure 5.1: Sirius Star Figure 5.2: Sirius Star Earlymen Drawing 5.2 Sky Transition For the day and night transition, I had to look for something mathematical that would allow me to create drives for sun and moon. Because we already know sun and moon position depends on some fixed position and rotation. Aristarchus of Samos Greek mathematician and astronomer who is celebrated as the exponent of a Sun-centered universe and for his pioneering attempt to determine the sizes and distances of the Sun and Moon. Aristarchus tried to learn about sun and moon position, rotation and elevation using trigonometry. After learning about this, I tried to find a solution for that. And luckily, in blender cloud system, I found a drive which indicates that if we use pi/2-atan2(sqrt(x*x+y*y),z) For sun elevation and, -atan2(-x,y) for sun rotation. We will get a good result of lighting which includes perfect degree of elevation depending on the sun rotation. That worked like a charm in blender Nishita sky driver Figure 5.3: Blender Sun position drive 5.3 Polar Present In this scene, I will be showing people the time when earth is frozen doing expedition on earth, and finding fossil rock that has painting of star done by early man which will be shown in the first scene "Savannah". This scene will be in the same place but representing a glacier or icy environment since thousands of years had passed. And research shows that, when years passes, erosion happens and fossils or rock come up to earth surface. And then its easier to find and collect fossils. It is very likely that Earth will turn cold again, possibly within the next several thousand years 5.4 Mars Based on research, it is possible to say that human life would go to mars and live there by the year 2040. And colonizing the mars would take another decade or two. After successfully landing on mars, there are some potentials discusses about the steps that we will be following and about how it's going to look like on mars. Such as becoming self-efficient, forming a community, making a culture, building bigger rockets and updating technologies. This will start with by living in domes. I tried to show that in the film. 5.5 Multiplanetary Human If complexity is "preferred" by the universe, then our planet has been a genuine diamond mine. For all we know at this point, the most advanced life forms in the cosmos originated on Earth. There is no branch of evolution that, according to the available scientific evidence, is more promising than our own. Ineffably complex forms of human and post-human life and technology will very likely arise if our earthly branch is permitted to persist. The underlying concept is that if we believe there is benefit (to the cosmos) in letting our branch of evolution to continue to develop and become more complicated in whatever ways, then we must make absolutely sure not to prematurely split this branch of evolution. "Existential risk" was defined by Dr. Nick Bostrom in his groundbreaking 2002 study. He said "Existential risk – One where an adverse outcome would either annihilate Earth- originating intelligent life or permanently and drastically curtail its potential. An existential risk is one where humankind as a whole is imperiled. Existential disasters have major adverse consequences for the course of human civilization for all time to come." This is exactly why we need to be a multiplanetary species. [8] 5.6 Doomsday This scene was inspired by an episode called "Three Robots: Exit Strategies" from the series "Love Death and Robots". Also, many other movies which are based on hypothesis inspired this scene. If we ever become a multi-Planetary species, there will be a separation between human population. There will be some categories of human who won't make it to the other planets. • People who would just want to live in earth • People who won't believe in space exploration and spending money on it • People who will be too poor to go to other planet or Mars For those people will be in earth will not survive a huge catastrophe that can destroy the earth. And in those moment, they will highly likely will accept their fate. This scene basically represents that situation. 5.7 All other scenes The next scenes of the film are also based on research, hypothesis and imagination. Such human will be exploring space and will colonize the mars fully. There will mars space station. At some point, human will find wormhole and ways to travel through it. The last scene represents, how we become what we are today, how we evolved ourselves from cave to modern world. We have always been explorers. And it's built into us by the evolutionary process that we never stay in one place without wandering what could be out there. This is exactly our next place to wander to is Mars CHAPTER 6 PRODUCTION I have developed the production process into two different types based on Blender production pipeline. And both of these two categories have many sub-categories. 1. Asset Production • Characters • Props • Environment asset library 2. Shot Production •

Animation • Cloth simulation • Texturing • Rendering 6.1 Asset Production The asset production goes all the time during the whole project, because the assets might change based on script requirements. 6.1.1 Characters Because of it's a totally individual project, I had to makeup time by collecting assets. Nowadays there are many tools, softwares and addons that can generate character models and allows to edit the models. In this case most of the time I used a Blender addon which is from a software called "Human generator". I also collected character models from Patreon page of a 3d artist named Ian Hubert. Figure 6.1: Characters made in Human Gen Figure 6.2: Mixture of Sketchfab and Human Gen characters Figure 6.3: Characters from Ian Hubert Patreon Page 6.1.2 Props Most of the props were made in blender. Some of them were collected from online and modified. As an example, the torch here is modeled in blender and then attached with the fire simulation work. On the other hand, the scanner machine was collected but it was attached with the custom-made hologram work. Figure 6.4: Props for characters 6.1.3 Environment Asset library The most important part was in the project for me was to make good environment. I have never done any environment before this project, and I had to study a lot of things such as Volume, Environment lighting, Mist work, Clouds and sky, Cloud shadows and many other things. To make it happen, I had to collect a lot of free and paid assets for environment design. I also created Landscape in software named 'World Creator'. Apart from main assets which are time consuming to model, I created other elements such as rock, grass, Planets and other material in Blender. I used Blender addon called 'Botaniq'. Also, some of the assets were collected from Patreon pages of many artists and then I used Geometry node to use them. And last but not least, Quixel Mega scan helped a lot for collecting environmental assets. There is a addon called 'Bridge' that helps to download and easily import the assets in blender for better workflow. Figure 6.5: Vegetation assets created in Blender Figure 6.6: Terrain assets created in World Creator Figure 6.7: Planets created in Blender Figure 6.8: Tree assets from Botaniq addon Figure 6.9: Patreon assets scattered by Geometry Nodes Figure 6.10: Paid and free assets from Kitbash3D 6.2 Shot Production The shot production goes step by step to make an organized production work. This part includes every work in the project such as making the environments, animating characters, objects and camera shots, Texturing, lighting and rendering. 6.2.1 Animation This part can be devided into two categories. Animation for characters and animation for other objects such as props, effects, moving things, vehicles, atmospheric animation and many more. 6.2.1.1 Character animation The hardest part was to animate the characters. Because I wanted to animate them frame by frame and not by using Motion capture data. The tricky part was to make the facial expression animation which required hundreds of keyframes. Figure 6.10: Frame by frame character animation 6.2.1.1 Camera shots and other animations For a film, the camera movements and types of shot are very important. Most of the time I used dolly and pan shots. Top view and follow shots were also involved in some scene. Apart from camera animation, almost each scene has a good amount of other animation such as spaceship flying animation, objects moving animation, atmospheric animation and most importantly various types of effects and simulation which require animation works. Figure 6.11: Camera animation using curved path Figure 6.12: Spaceship animation using path and keyframing Figure 6.13: Ship booster animation using shader editor Figure 6.14: Mountain transformation animation using shape keys Figure 6.15: Meteor falling animation using fire simulation Figure 6.16: Building transformation using Build modifier Figure 6.17: Rover rig and animation using geometry node 6.2.2 Cloth Simulation For cloth simulation I used a different software called "Marvelous Designer". This was important because at one scene I wanted to show wind blowing the cloths of the characters, also because of there was no cloth assets that could fit on the scenes. Figure 6.18: Cloth simulation on Marvelous Designer 6.2.3 Texturing Materials and textures are the essential components of every physical item. Textures and materials, from the softness of cashmere to the hardness of steel, give anything they are applied to a distinctive feel and appearance. Textures and materials can be blended to provide a lovely and distinctive look, whether the materials are smooth leather, gritty jute, or shiny metal. The appropriate blend of textures and materials can offer the ideal balance of strength and appearance, as different materials can offer varying degrees of flexibility, weather resistance, and longevity. In this case, I had to do a very good amount of texturing works. From the rock to the planets, everything was custom textured. And to do that I used Blender shading editor as well as Photoshop. Figure 6.19: Texturing work on Hill and Rock Figure 6.19: Texturing work planet and terrain 6.2.4 Rendering For rendering I used Blender cycle render. The physically-based path tracer for production rendering in Blender is called Cycles. It is made with creative control and adaptable shading nodes for production needs in mind, and it is intended to deliver physically based results right out of the box. It also allows to use full power of a Graphics Card. I used a Nvidia 3090ti for fast rendering. And for better result I used the following settings. Render Samples Number of paths to trace for each pixel in the final render. As more samples are taken, the solution becomes less noisy and more accurate. For most the of the scenes, it was around 1000-2000. Render Denoising for the final render can be enabled or disabled with the checkbox. For denoising the image after rendering with the Denoising node, the Data Render Passes also adapt to the selected denoiser. In my work, I used optix denoiser. OptiX uses an artificial intelligence algorithm to remove noise from

renders. It is based on the OptiX – NVIDIA acceleration engine and therefore has the same GPU requirements as rendering with Optix. Light path Transparency Increased light path transparency allowed to use images as plane. This helps to use many planes in a single location without any banding issue Render Layers For better composition, I rendered each scene in multiple render layer. In that way, I was able to tweak various part of a scene. Output For output, I used PNG format with RGBA color and 16bit of color depth. CHAPTER 7 POST-PRODUCTION So, for the post production work, I again went for blender in built composition panel. Same as other parts, Blender composition works on Node system and this is why its very easy to use. Some of the benefits of composition are Bright/Contrast node, Hue Saturation Value, RGB Curves, ColorRamp, separating parts of the image one from another, data passes, Glare node, Mix Node, Blur Node, Mask Node and many more. Figure 7.1: Composition in Blender I used Adobe after effects for the tile reveal animation. Making the text from Adobe illustrator and then bringing it after effects was the main process. Then I animate each element frame by frame and completed the title animation. Figure 7.1: Title animation in After Effects The post-production workflow of a video editor is the focus of Premiere Pro. For content producers and filmmakers to manage and edit video files as well as improve and fine-tune audio and image quality, it is supplied with a suite of potent editing tools. Figure 7.1: Final edit in Premiere Pro CHAPTER 8 DISCUSSION The short film takes the viewer on a journey that spans from the beginnings of human civilization to a future where humanity has successfully colonized Mars. By drawing parallels between our primitive past and the challenges of colonizing a new planet, the film highlights the incredible progress that humanity has made and the immense potential that lies ahead. Through the use of stunning visuals, the film captures the beauty and harshness of the Martian landscape, showcasing the engineering and technological achievements required to sustain human life in such a hostile environment. The narration by Carl Sagan, in his speech "A message to Mars," provides a powerful message of hope and inspiration, emphasizing the importance of scientific discovery and exploration to human progress. The film ultimately encourages viewers to embrace the spirit of exploration and the pursuit of knowledge, reminding us of the importance of looking to the future with a sense of optimism and possibility. By highlighting the incredible progress that humanity has made in the past and the potential for even greater achievements in the future, The short film serves as a powerful reminder of the strength and ingenuity of the human spirit. The short film is reminiscent of Erik Wernquist's And many other science fiction works. Through stunning visual depictions of planets and moons in our solar system, the film takes the viewer on a journey of exploration and discovery, highlighting the immense potential for human space exploration and colonization. The use of CGI technology adds a unique and immersive dimension to the film, allowing for the creation of highly detailed and realistic environments that transport the viewer to distant worlds. The visuals are further complemented by the carefully selected and expertly crafted soundtrack, which enhances the emotional impact of the film. CHAPTER 9 CONCLUSION In conclusion, "Multiplanetary Life" is an impressive and inspiring work of CGI filmmaking. Through stunning visuals and the use of Carl Sagan's powerful message, the film takes the viewer on a journey from our primitive past to a hopeful and exciting future. As a Bangladeshi CGI artist, this film can serve as an inspiration to push the boundaries of creativity and technological innovation to produce even better works of art. The production of this film has allowed me to develop essential skills in 3D modeling, animation, and visual effects, while also honing my own production pipeline. This process has given me the opportunity to refine my creative process and develop my artistic vision, pushing me to achieve new levels of technical and creative mastery. The making of "Multiplanetary Life" has also been an enjoyable and fulfilling experience, allowing me to explore new frontiers in the world of CGI filmmaking while also contributing to the broader conversation around space exploration and the human desire for discovery and adventure. In summary, "Multiplanetary Life" is a powerful and inspiring work of CGI filmmaking that serves as a testament to the incredible potential of human creativity and innovation. By pushing the boundaries of what is possible, you have demonstrated your ability to bring to life a vision of the future that is both beautiful and thought-provoking, and which will inspire future generations of artists, scientists, and explorers. REFERENCES [1] The great train Robbery. https://www.britannica.com/topic/The-Great-Train-Robbery-film-by-Porter (January 04, 2023). [2] ANNNGUYENANH , (February 17,2015) Narrative animated films https://annnguyenanh.wordpress.com/2015/02/17/animation-narrative-and-the-differences-of- narrative-in-animated-films-between-east-asian-and-western/ [3] Kodi-Lists, (January 26, 2017). 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