FOSSEE Fellowship Report On

Graphics and Animation in Blender 3.1.1

Submitted By

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Acknowledgement

I would like to express my sincerest gratitude to **Prof. Kannan Moudgalya** whose vision of FOSSEE has enabled me to unleash my creative side. I extend special gratitude to my project mentor, **Mr. Khushalsingh Rajput, SPSE (Graphics and Animation)**, who's constructive suggestions, empowering guidance and encouragement, helped me to build a successful project.

I thank them for ceaseless support throughout the fellowship, add to that their valuable feedback, intuitive approaches, and perspective towards working. I also appreciate the guidance given by my fellow-mates for their support and guidance in the journey of this fellowship.

I perceive this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way and I will continue to work on their improvement, to attain desired career objectives. I also hope to continue cooperation with all of you in the future.

Contents

Objective

The Main Objective of this fellowship is to create **3D educational animation** videos for students that would help them to understand their topics. These videos should be clear, simple and short that can relay the topic as easily as possible.

The primary objective was to create the videos but in the process of it we also had to make 3D models with textures and sometimes animating extensively in Blender. So, the side goal is to introduce Blender to the people who are interested in 3D arts and get them started by providing them with free 3D models, textures, tutorials and many more things.

About Software (Blender)

Blender is the **free and open-source** 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation. Advanced users employ Blender's API for Python Scripting and Story-Boarding to customize the application and write specialized tools. Blender is well suited to individuals and small studios who benefit from its unified pipeline and responsive development process. Examples from many Blender-based projects are available in the [showcase](#).

Blender is cross-platform and runs equally well on Linux, Windows, and Macintosh computers. Its interface uses OpenGL to provide a consistent experience.

As a community-driven project under the [GNU General Public License (GPL)](#), the public is empowered to make small and large changes to the code base, which leads to new features, responsive bug fixes, and better usability. Blender has no price tag, but you can [invest](#), [participate](#), and help to advance a powerful collaborative tool: Blender is your own 3D software.

For this project we will be using Blender 3.1.1 version and Eevee renderer for the rendering process.

Project Workflow

Selecting topics

For creating animations, the topic should be something which needs 3D visualizations to be understood clearly and which can be compressed in 2 minutes video without creating any confusion.

I selected 2 topics for animations Fleming's left- and right-hand rule and Reflection of light by plain mirror.

I also wanted to create a separate dedicated detailed 3D model of human face.

I also made a short and simple tutorial on how to animate that face model and making it smile and sad.

Idea and Reference finding

As per the initial discussion with the mentor, a goal to create educational content was set out for the participants. The purpose of such a task was to make information about the topic easily consumable by the students.

As a starting point, I took Physics NCERT books and researched about the topics primarily. For details I went to Wikipedia, Electrical4U, Byjus and Vedantu pages of the topics because they have explanations precise and short which is great for a video.
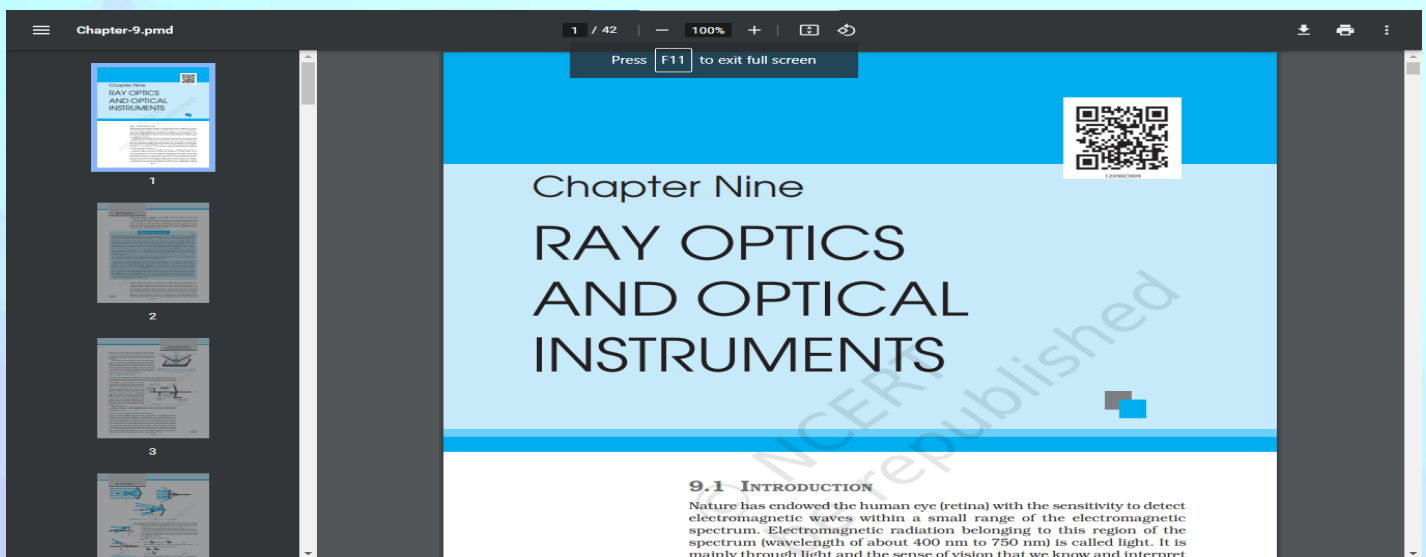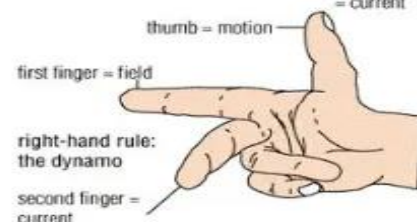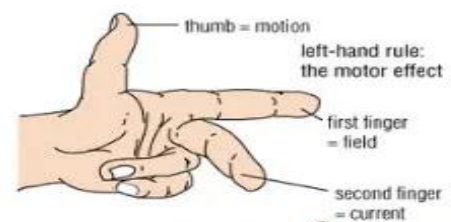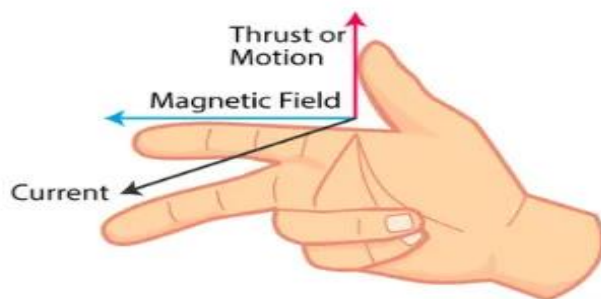
Scripting and Story-Boarding

The next important question was what story to tell through animation. It's important for the content and sequencing of the things to explain in a video. The narration for the video also gets very easy later when the scripting is already done. I wrote a small script noting down the important points about how the animation will proceed and outlined a rough sketch for the video.

The screenshot shows a Google Docs storyboard document with the following content:

First document (Fleming's left and right-hand rule):

animation of the direction of current, magnetic force and magnetic field in a current carrying conductor.		Whereas in Fleming's right-hand rule When a current-carrying conductor is exposed to a magnetic field, it experiences a force. Electric current can be induced in a moving conductor when it is set in a magnetic field. Fleming's Right-hand rule can be used to determine the direction of the induced current. (narration)
animation of the direction of the three parameters.		It's important to remember that these rules don't specify magnitude; rather, they indicate the direction of the three parameters which are magnetic field, current, and force when the other two parameter's directions are known. Now let's try to visualize them in our hands one by one. (narration)
animation of the direction of current, magnetic force and magnetic field in a current carrying conductor with ref. of hand.		**Fleming's left-hand rule** If we arrange the thumb, the center finger, and the forefinger of the left hand at right angles to each other, then the thumb points

Second document: Storyboard & Script (Reflection)

Storyboard & Script (Fleming's left and right-hand rule)

On Screen Action (short description)	Type (image/text)	On screen Narration
animation of Topics	Text slide	reflection of light (narration) (Text appears)
animation of a man in front of mirror		Have you ever thought about why we can see our image in a plane mirror? It's because of the phenomenon known as reflection. Light waves, sound waves, and water waves can undergo reflection. In this session, let us learn about the reflection of light and the types of reflection in detail.
animation of reflection in a mirror		**What is Reflection of Light?** When a ray of light approaches a smooth polished surface and the light ray bounces back, it is called the reflection of light. The incident light ray that lands on the surface is reflected off the surface. The ray that bounces back is called the reflected ray. If a perpendicular were drawn on a reflecting surface, it would be called normal.

Modeling and Texturing

After compiling my thoughts, the next step was to create a 3d models for the video. Using the reference, I made 3D model of hands which was must in this particular video.

Further, I also created other required objects like a battery, a pair of magnets, a bulb, a baseboard, a table, the room, different type of wires, etc. which were essential for the animation.

Giving real-looking textures to the 3d models was the next step. There are different ways to texture a model in blender using free PBR textures from internet or using image textures by unwrapping the models or by procedural nodes. I used shader materials for giving them a nice look and feel. I use HDRI for the lighting of the scene.

Rigging and Animations

The step that adds life to a model and environment according to the script and time frame, which is Rigging was the next step now. First, I created rigs for the objects. The rig is like the muscles of a human body, which can move the parts of the object.

In the animations, most of the objects has movements so I had created rigs and curves for these objects. The next step was to animate the objects frame by frame and complete the animation. I animated different sections with different cameras for each different dialogue in narration. This method made animation easier and more organized. I can change a section of the video without disturbing other sections.
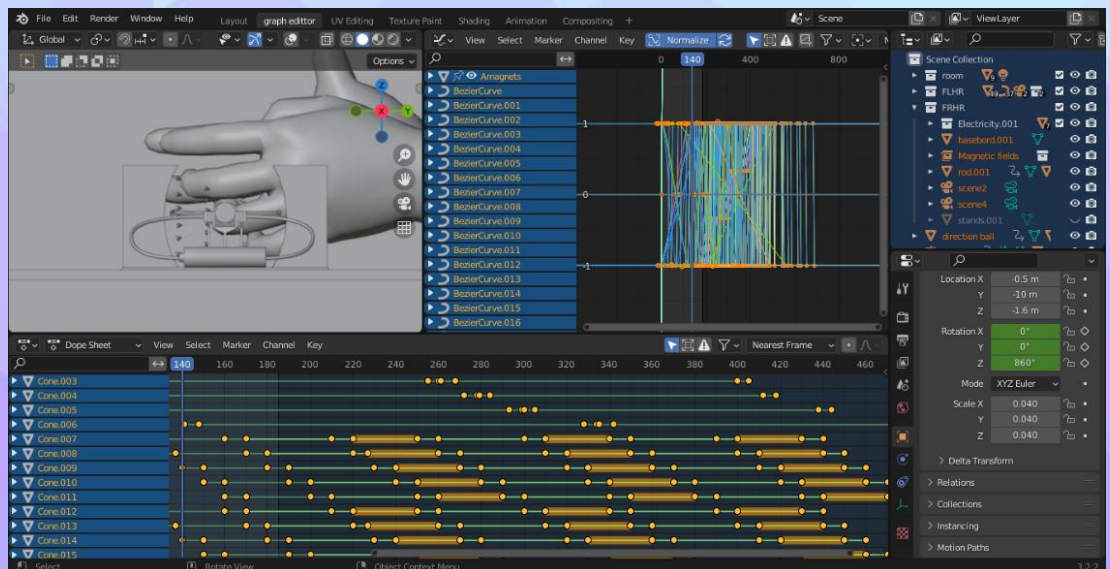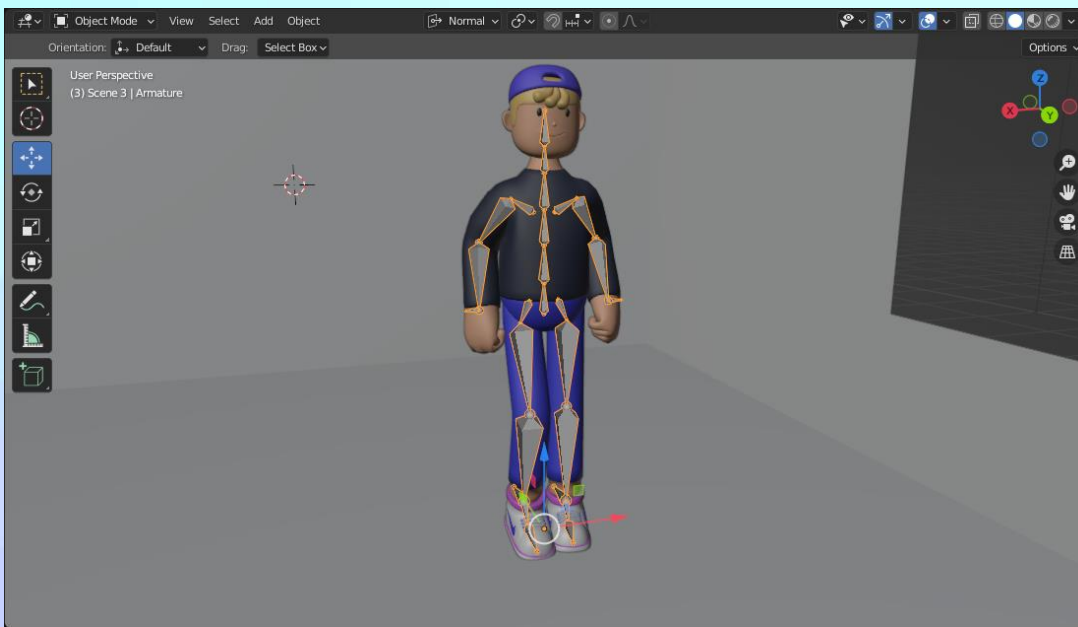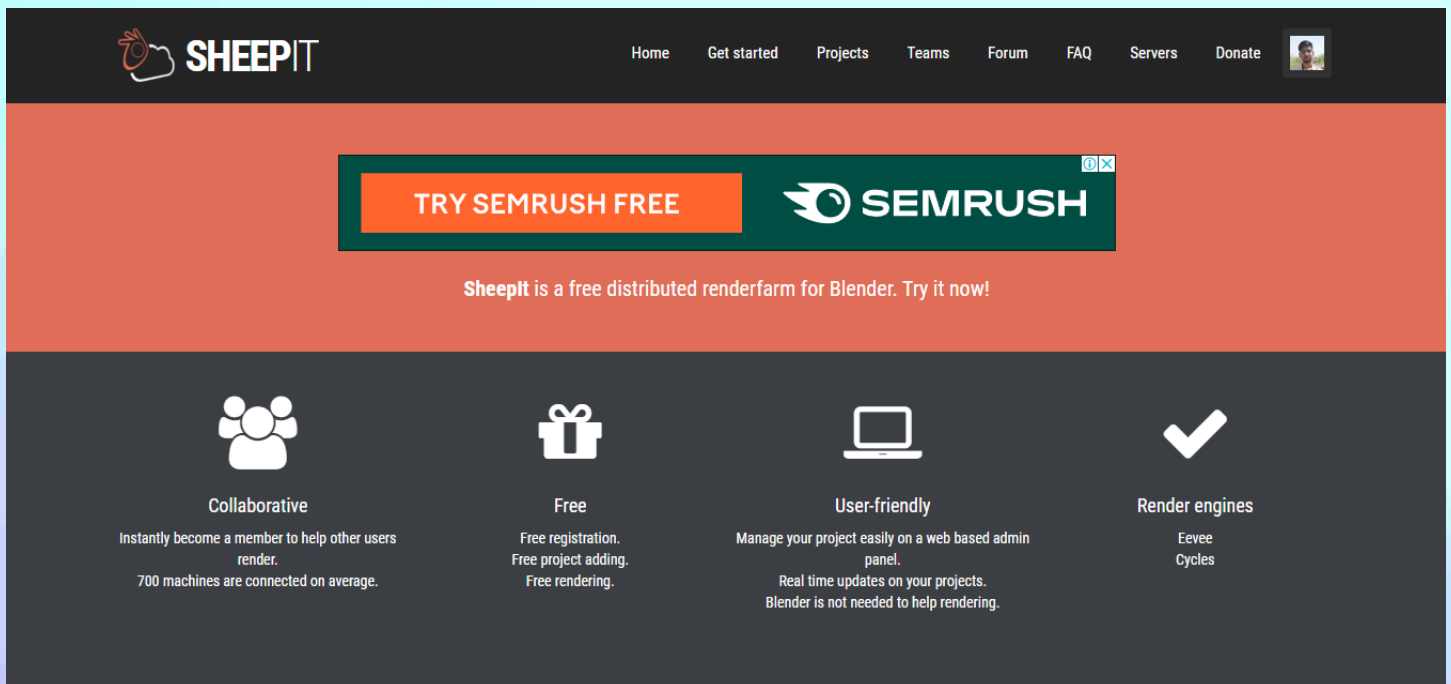
Rendering

After satisfactory outputs, a single **.blend** file is created and is put on the **SHEEP**IT render farm to let all keyframes render which uses community hardware for rendering and it renders faster than normal render time.

There are two main engines for rendering in Blender **EEVEE** and **Cycles**. EEVEE is easy on your hardware and take less time than cycles but it compromises on the quality of render in shadows and lighting data. Cycles render the scene more realistically but it takes a toll on your hardware and takes much more time.

I used EEVEE render engine for my videos, as my animations are more on the explanatory side rather than realistic.
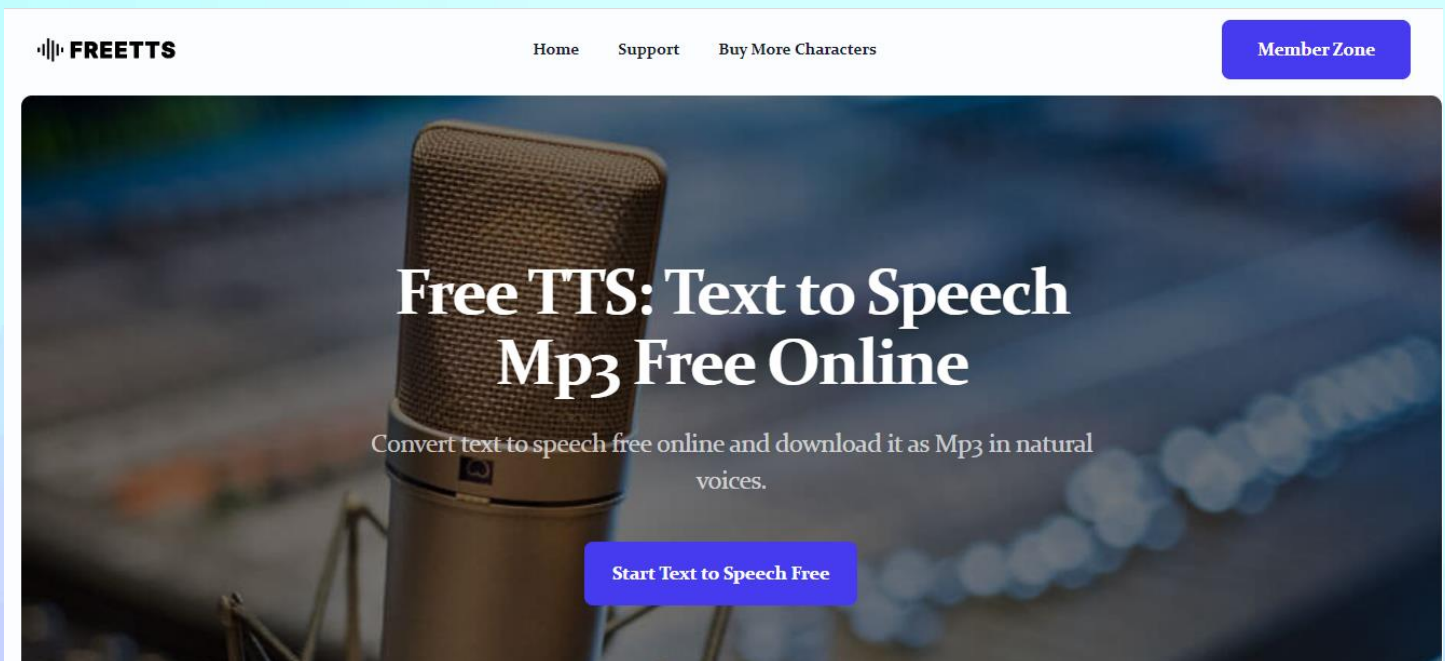
Narration

The step that adds energy to these videos, which is adding audio/ narration was the next step now. For the narration we already have a script, we can narrate it by ourselves (if you have a good microphone), or as I did it by using a free website for text to speech narration using AI.

It did a good job of replicating human speech and it felt less computerized and clear.

Audio and Video Editing

The rendering process gives us as output, each frame of the animation as a .png image. A 2 - 2.5 minutes, 30 fps animation video has around 4000-4500 frames. These frames are then loaded into blender's very own Video Sequence Editor (VSE). The frames are arranged in accordance with the script and the storyboard. This step is only to make sure that all the frames conform to the script as well as the storyboard. In this process I also added some little effects in video so that video will look a lot smoother.

It's time to mix these video files with the audio that we created earlier and add some texts too for detailed information.

So now we come to stag where we synchronize our dialogue and sound effects with the animation. Then the viewer will get the complete visual and audio effect which will create that feeling of watching something informational yet engaging.
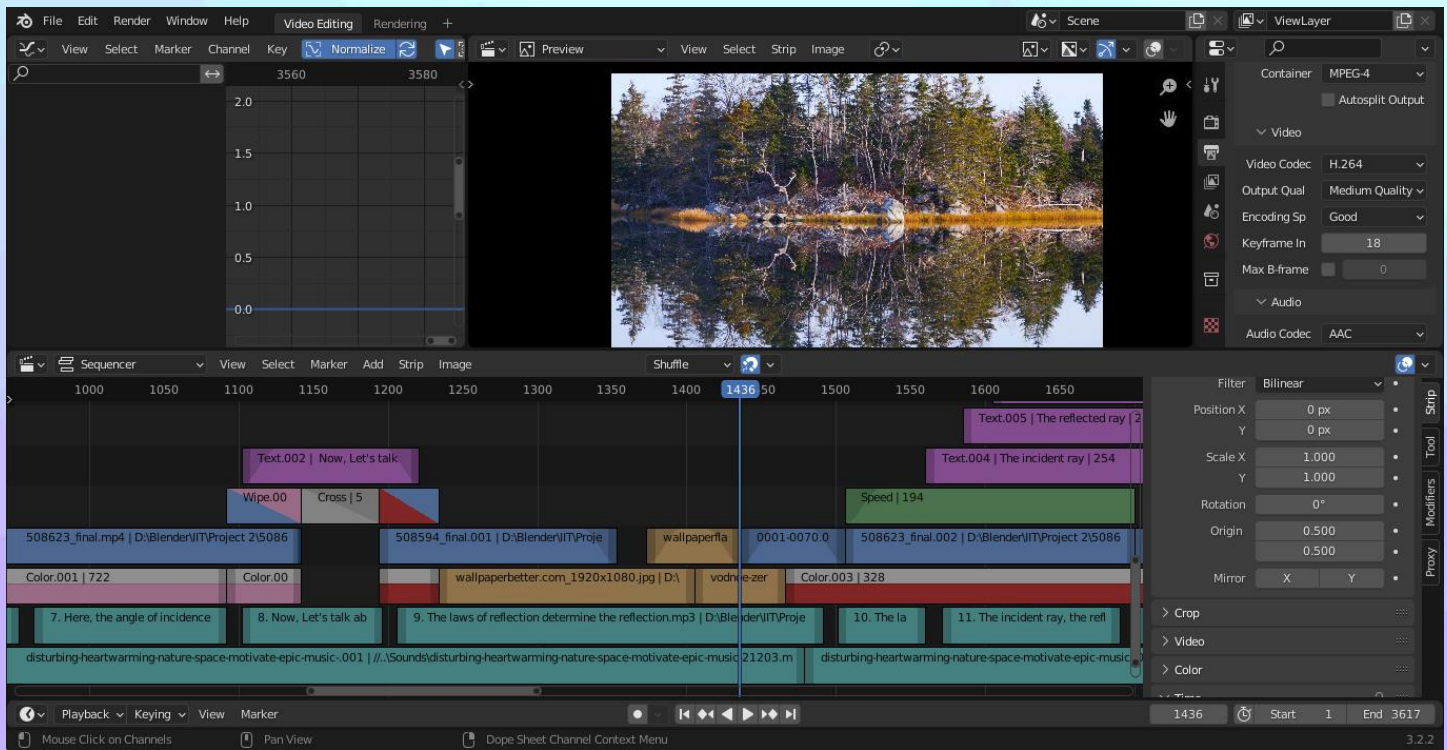
Final output

After editing the video, locally rendering the video in **FFmpeg** file format with **mp4** encoder of **H.264** video codec with the audio with **AAC** audio codec and **Stereo** Audio channel was performed.

On getting the output, now all that is left is re-editing and rendering continued until satisfactory results were achieved.

Issues faced and their solutions

During the execution of the first and second task where the primary issue faced by me was coming with a good script and story board which should be easily understandable, engaging and as short and simple as possible.

To solve that issue, I had done a lot research about the topic and gathering all the relevant information as I could and then rejecting less important segments filtering out those which were making the videos longer.

During the execution of the third task where detailed 3D model of human face was to be prepared, the problems I encountered was that it was not easy to get a proper reference that had the correct aspect ratio and dimensions of front and side views.

To solve that issue, I had done a lot research throughout the internet and found some good reference. But you can also draw the reference on your now if you want.

During the execution of the fourth task where I made the tutorial on making sad and happy face by moving lips and eyes. The main problem I faced was to cover everything important within the time limit of 10 min which was given to me.

To tackled this issue, I had to speed-ramp most of part of the video.

Weight-painting the bones was the most hectic part among the entire things in the fellowship. But with few efforts it was all done and was extremely satisfactory to work on something like this.

Bibliography and References

❖ **Theory Research**

➢ Wikipedia
➢ Electrical4U
➢ Byju's
➢ Vedantu

❖ **Image used/reference**

➢ Google
➢ https://stocksnap.io/

❖ **AI voice**

➢ https://freetts.com/

❖ **Background Song**

➢ https://pixabay.com/music/

❖ **Open-Source Websites**

➢ SHEEPIT Render-Farm
➢ Poly-haven

❖ **Software Used**

➢ Blender (For almost everything)
➢ Audacity (For voice/audio recording)
➢ OBS (For screen recording)