



# Summer Fellowship Report

On

**VR(360°) Animation Using Blender**

Submitted by

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# Chapter 1

## Introduction

### 1.1 Objective

The objective of my project was to create virtual reality animation videos using Blender. The target audience is any learning enthusiast who wants to comprehend the concepts of electricity, of wide-ranging levels of difficulty, from the very basics like electric current, to quite advanced topics like Ampere's Law. The intention was to subtly initiate a transformation from 2D animated educational videos to 360°VR animated educational videos, as the learning medium for enthusiasts. Evidently, the reason for having chosen such a medium is that, a 360° virtual environment eliminates the effort a learner has to put into visualizing concepts, thereby drastically reducing the time taken to comprehend a certain concept. The **open source** chosen to create the videos was **Blender 2.79b**.

### 1.2 About Blender

Blender is a software primarily used for 3D animation. It has other versatile functionalities that include 3D modelling, digital sculpting, video editing, UV unwrapping, texturing, raster graphics editing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body simulation, rendering, motion graphics and compositing, to name a few.

On January 1, 1998, Blender was released publicly online as SGI freeware. In May 2002, Roosendaal started the non-profit Blender Foundation, with the first goal to find a way to continue developing and promoting Blender as a community-based open-source project.

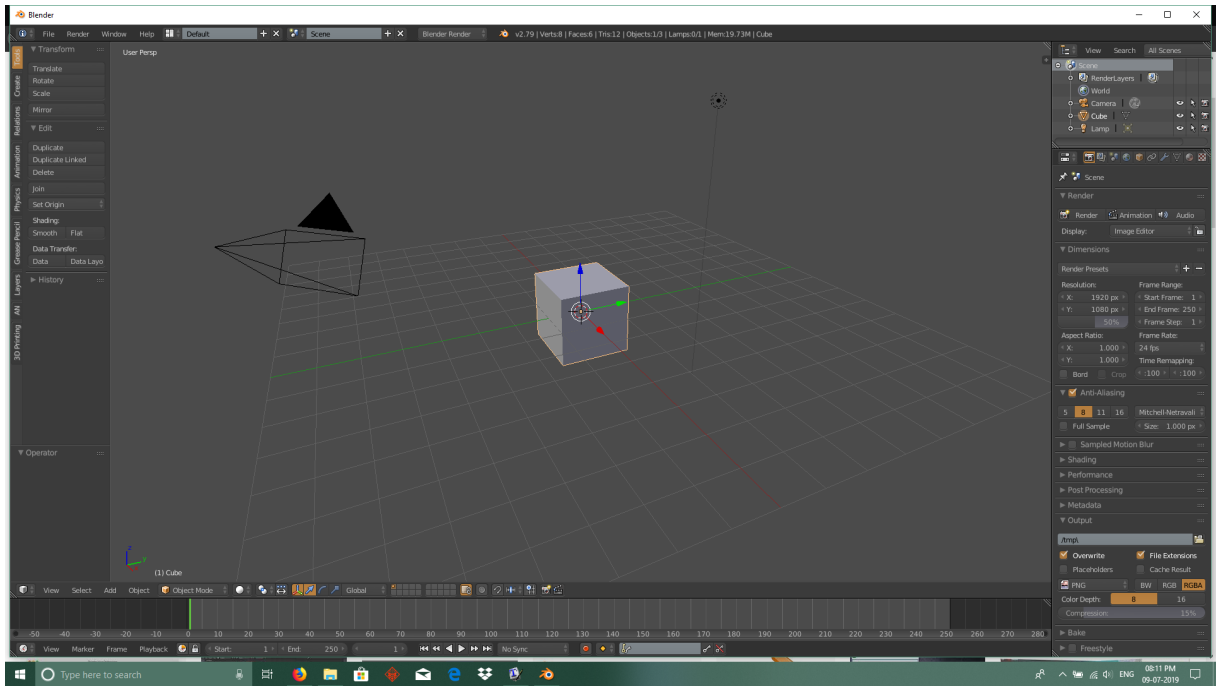


Figure 1.1: Blender 2.79b User Interface

# Chapter 2

## Project Workflow

### 2.1 Concept Study of particular subject

This is the first step of the workflow and is alternatively called the ideation phase. In order to ensure that the final product or deliverable i. e the 360° animation video was conceptually sound, this phase was pivotal and therefore required much of our focus and dedication. This phase involved looking up information on the specific topic assigned and building up an intuitive idea of the topic.

Extensive use of **wikipedia** and **youtube** was made to properly comprehend the topics in order to eventually come up with an apt portrayal by means of animation. This phase usually ends when one gains a concise idea of what are the core concepts one must portray, in order that the learner may understand the topic.

### 2.2 Scripting

With the concise idea now established, the story is written. This process is called **scripting**. **Microsoft Office Word** was used to write the script. The script consists of a table divided into two columns. The first column titled "Narration" contains sentences that would eventually serve as voice overs at certain parts of the video.

The second column titled "Visual Cue" contains a detailed textual description of what must be shown on-screen in sync with the narration.

Narration	Visual Cue
Electric current	"Electric Current"- Text appears Text disappears
An electric current is the rate of flow of electric charge past a point or region per unit time.	"An electric current is defined as the rate of flow of electric charge past a point or region per unit time."- Text appears(typing effect) Text is scaled down and moved to the bottom of the screen.
	A circuit appears with a copper wire, battery, ammeter and resistor. Zoom into the copper wire.
	Electrons are shown flowing from one end to another end of the wire.
	A plane (cross-section of area) appears in the middle of the wire and the moving electrons are paused according to unit time clock. Simultaneously, the keywords of the definition are highlighted. The plane disappears and flow resumes
The electric current is measured using an ammeter.	"The electric current is measured using an ammeter."- Text appears Zoom into the ammeter of the circuit.
The SI unit of electric current is ampere or amps.	"The SI unit of electric current is ampere or amps." - Text replaces previous text while ammeter is on display Highlight the word "Ampere" on the ammeter
Ampere is represented by 'A'.	"Ampere is represented by 'A' "- Text replaces previous text Highlight A on the ammeter

Figure 2.1: Example Script for the animation titled **Electric Current**

## 2.3 Storyboard

After the script is prepared, a rudimentary pictorial depiction of the entire animation is done. From the **Visual Cue** column in the script, the most important frames are identified and then depicted as a still picture. This can either be hand-drawn images or images created in any vector graphics software such as inkscape.

**Inkscape** was used for the purpose of creating the storyboard.

## Storyboard - Electric Current

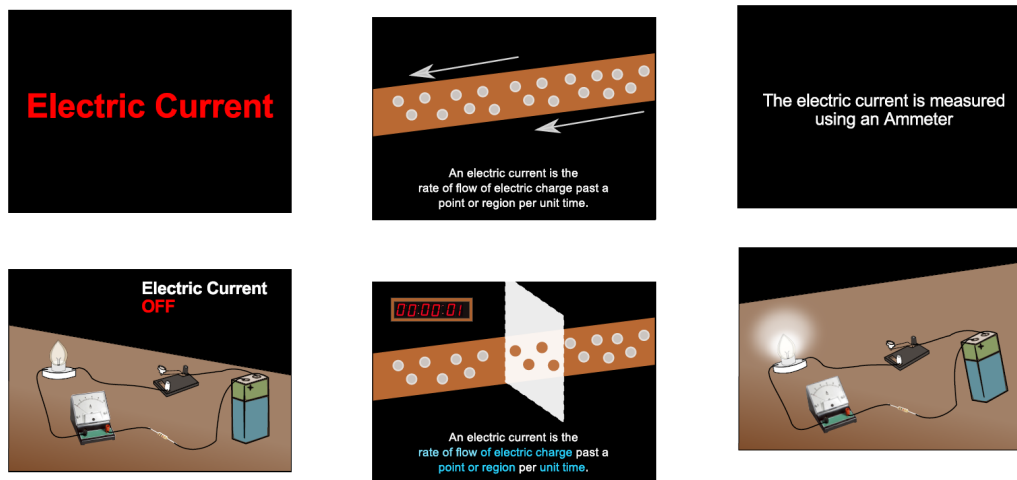


Figure 2.2: Example storyboard of the animation titled **Electric Current**

## 2.4 Animation

Finally, we get into **Blender** to begin with the animation process. This is has several steps to it, which is explained in detail in **Chapter 3** of this report.

## 2.5 Video Editing

After the animation is done, the **.blend** file is put for rendering. For this purpose, we have used several means which are elaborated in **Chapter 5**.

The rendering process gives us as output, each frame of the animation as a **.png** image. A two-minute animation video has around 2000 to 3000 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 conforms with the script as well as the storyboard. Any improvisation pertaining to visual appeal is also made at this stage of the workflow process.



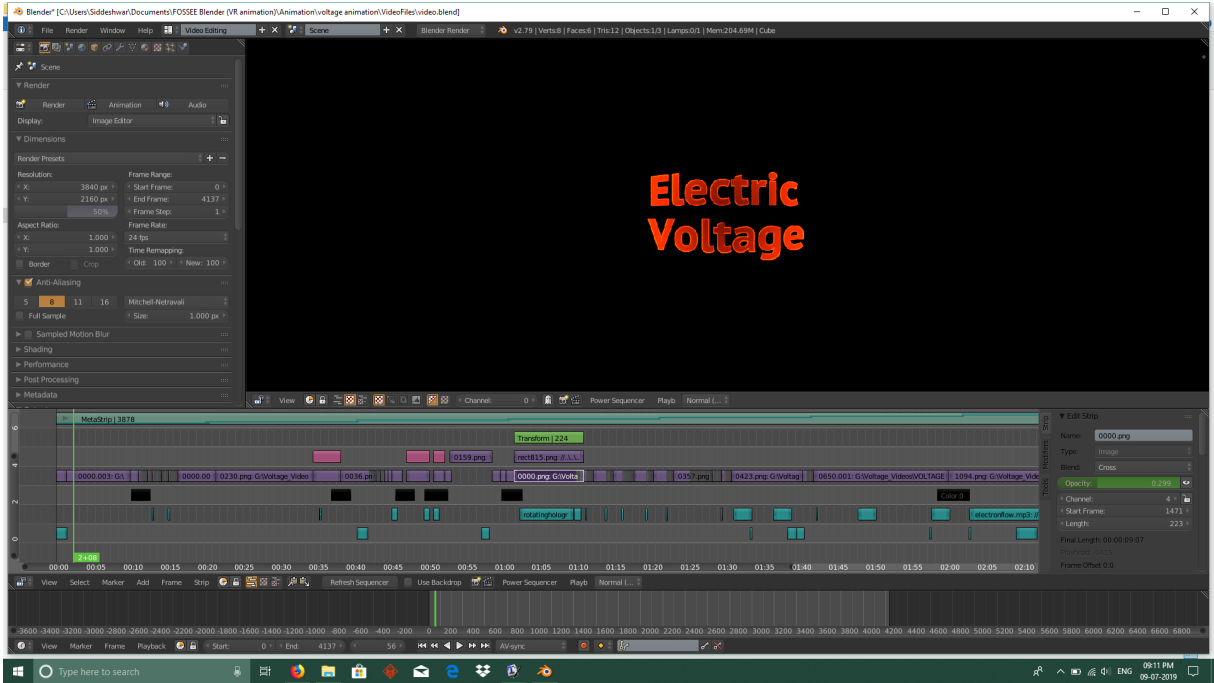


Figure 2.3: Blender VSE Workspace of the animation titled **Electric Voltage**

## 2.6 Test Screen

Once the final sequence of the animation video is obtained, the frames are converted into an **mp4** file. It is then viewed using a mobile phone and a VR headset to ensure that every scene has the intended effect and visual appeal that we had in mind during the ideation phase.

Changes of any kind are not tolerated or accommodated after this phase and therefore any non-conformity to the storyboard or script is thoroughly identified and removed in this phase.



Figure 2.4: VR Headset

## 2.7 Post Processing

Post processing involves the following:-

1. Adding sound

I used a software called LMMS to generate the background music for the animation titled **Electric Current**. Also, the sound effects were taken from the software's in-built sound.

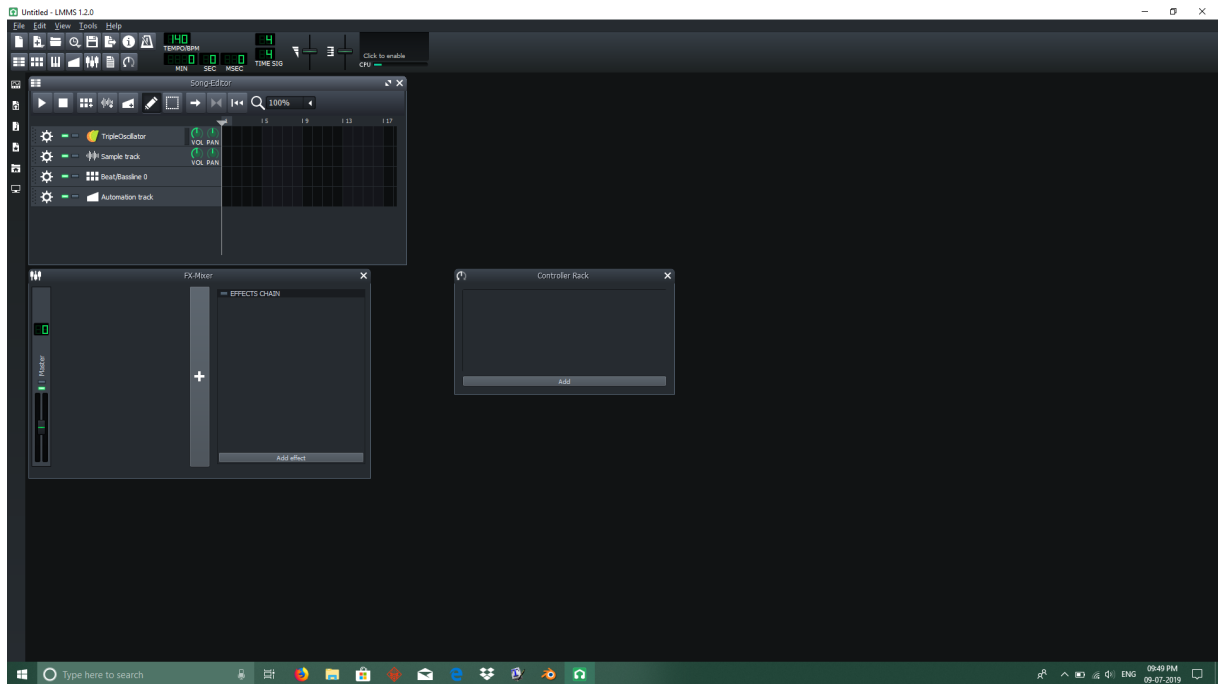


Figure 2.5: LMMS User Interface

2. Color Corrections

This is a very common part of the post processing workflow. This ensures that the final output looks visually appealing. However, my animation video did not require any color corrections.

# Chapter 3

## Animation Workflow

### 3.1 Modelling

The first step of any computer graphics animation is to design the objects portrayed in the animation. This process is referred to as modelling. Some of the components modelled as part of this project were:-

- Battery
- Battery Holder
- Resistor
- Ammeter and Voltmeter
- Bulb Holder

Other models used, were taken from online sources that offered 3D models under the creative commons license.

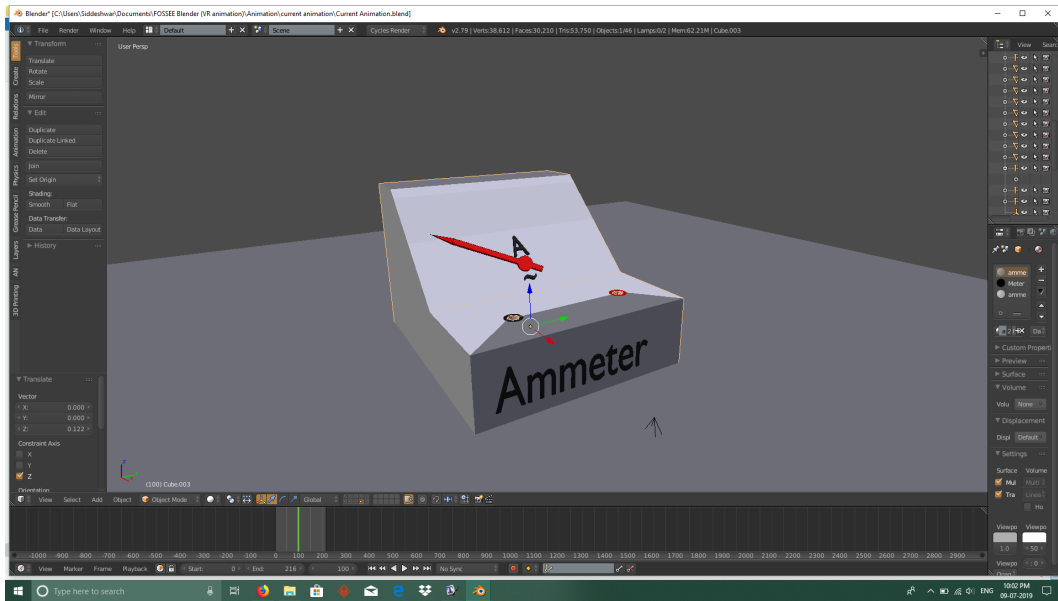


Figure 3.1: 3D Model of Ammeter used in the animation video titled **Electric Current**

## 3.2 Texturing

Once the 3D model is done, material is added to it. This step is pivotal in making sure the 3D models appear photorealistic. Blender's cycles render engine has been used and material nodes have been used extensively.

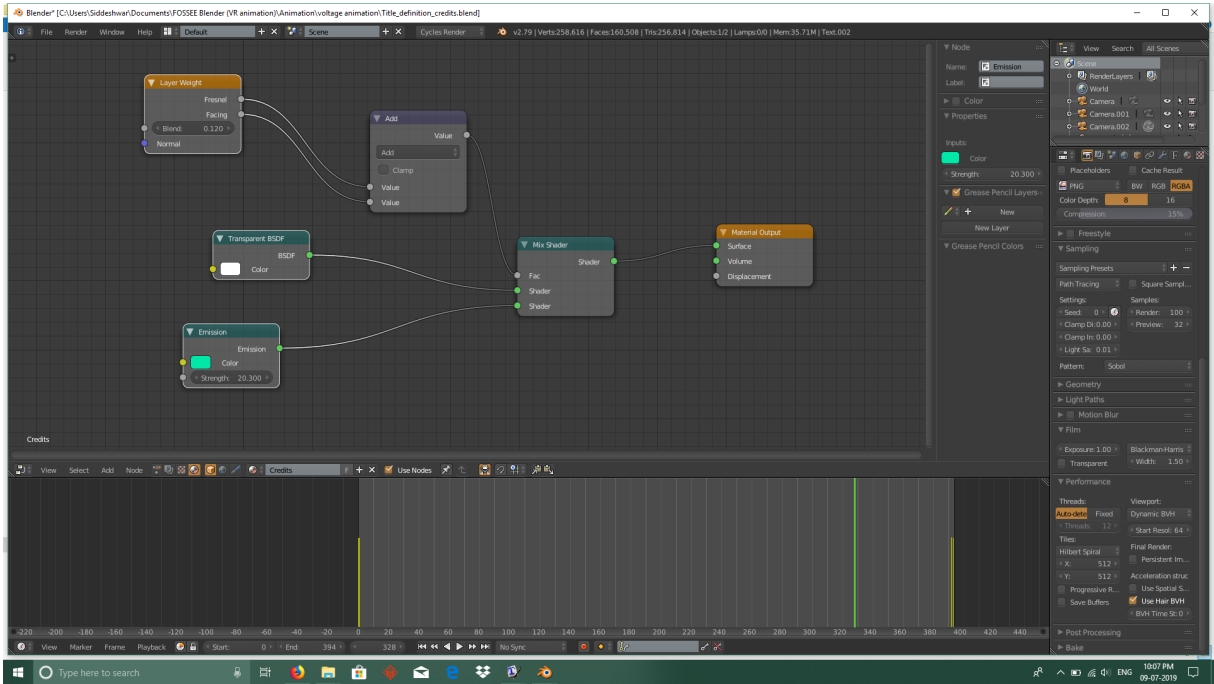


Figure 3.2: Material Node set up for all the text in the animation video titled **Electric Voltage**

### 3.3 Animating

There were two different methods of animation that were used throughout the project:-

#### 1. Keyframing

This is the conventional method of animation which involves saving the rotation, location and scale information of the object to be animated, at particular frames.

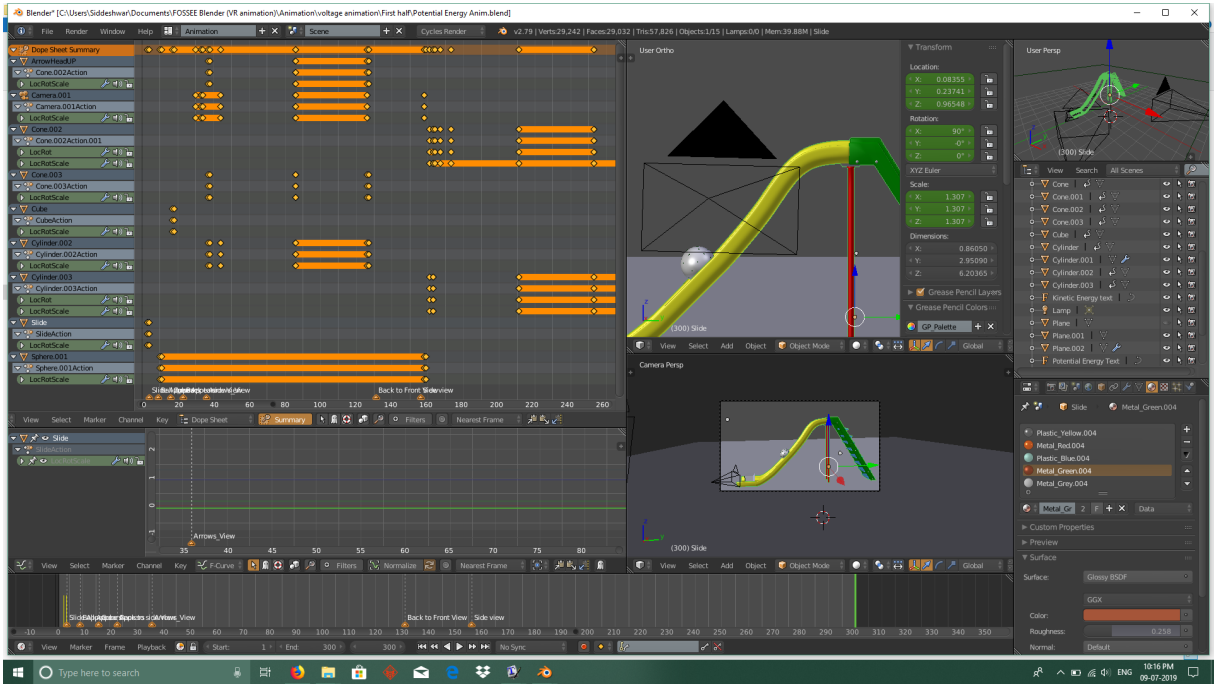


Figure 3.3: Dope Sheet depicting keyframes for the animation video titled **Electric Voltage**

## 2. Animation Nodes

This is a blender add-on that is used to do procedural animation. This add-on was primarily used to create the text animation. The text was animation to give a typewriter effect.

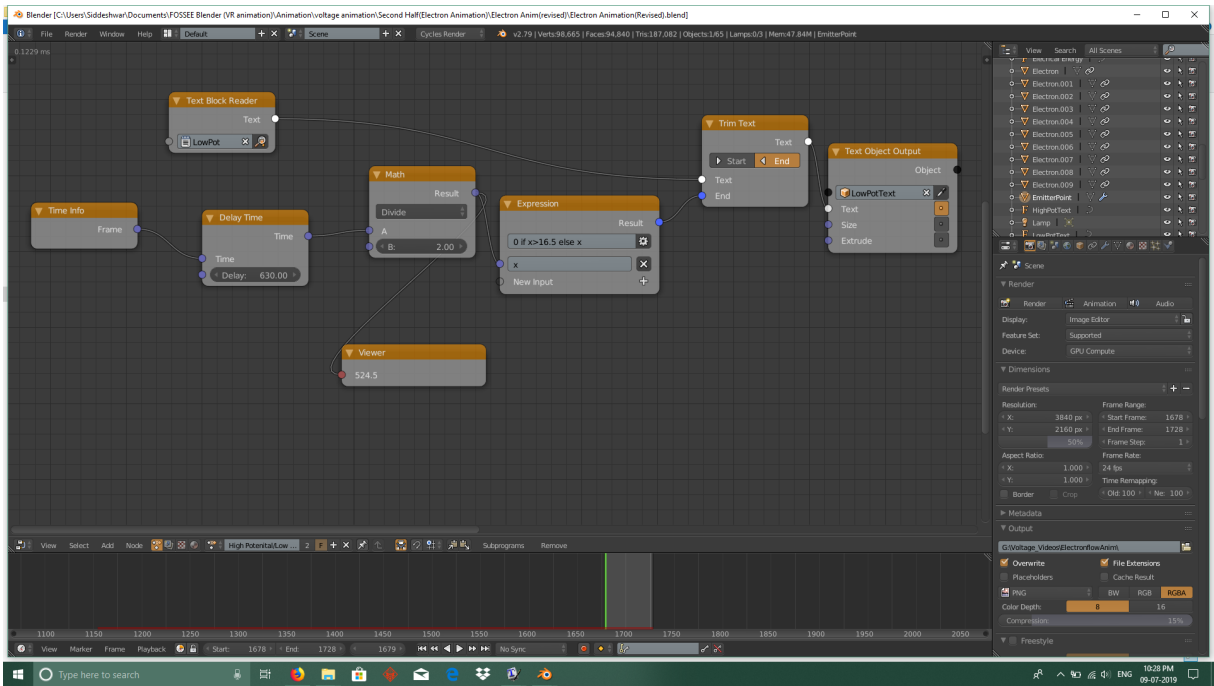


Figure 3.4: Animation Nodes set up for text typewriter effect in the animation video **Electric Voltage**

# Chapter 4

## Project Description

Below is a detailed description of the animations that I have worked on during my internship period.

### 4.1 Electric Current

First, the title **Electric Current** is displayed using the typewriter text effect. The title disappears into the table and all the components required of the electric circuit appear in the following order:- battery, switch, resistor, bulb, ammeter and finally the wires. A demonstration of turning the circuit on and off is shown indicating that electric current flows through the circuit whenever the switch is turned on and flow stops when switch is turned off.

The camera then zooms into the wire and the scene cuts into an inside view of electrons flowing in the wire. The definition of electric current is displayed using the typewriter effect animation. The scene then cuts out to the view of the electric circuit. The ammeter is then shown in close-up and the SI unit of current is shown textually.

### 4.2 Electric Voltage

The title **Electric Voltage** is displayed followed by the definition of electric voltage. A slide with a ball at the top and a wooden cube at the bottom is shown. The ball is shown to move down the slide and hit the wooden cube. This indicates a conversion of potential energy to kinetic energy and serves as an analogy to the concept of electric voltage. Also, to indicate that voltage and gravity are similar ideas, an apple is shown falling from a tree. Both the apple and the tree are mere 2D images imported as planes in Blender.

A holographic inverted frustum is shown revolving. The camera then zooms into the inverted frustum where a glossy plane appears followed by all the required electric components. The battery is then shown up-close and the negative terminal is shown to be at a higher potential and the positive terminal is shown to be at a lower potential. Then a visual analogy is made between the battery and the slide seen in the previous scenario. The camera then shifts its view to the wire. The



wire is gradually made translucent, the circuit is switched on, and electrons are shown to flow through the wire. A visual indication of chemical energy being converted to electrical energy is shown. Finally, the SI unit of voltage and its notation is shown followed by the credits.

# Chapter 5

## Limitations Encountered and Overcome

### 5.1 Hardware Limitations

The animation videos we set out to make were at least 2 minutes each, which meant roughly 3000 frames per animation. Each frame rendered at an average of one and a half minute on a NVIDIA GTX 1070 GPU. This brought the total render time to roughly 3 days. This was impractical considering our deadline and the amount of work to be completed. So I had one of two choices left:-

- Upgrade to a better hardware (in terms of GPU)
- Use an online render farm

As a result I made use of an online render farm called **Sheepit**. But one limitation however was encountered even with this.

### 5.2 Render Farm Limitation

I used an add-on called **Animation Nodes** for all of the text animations. These text animations however did not render out when uploaded to sheepit. I posted a question on the blender stack exchange regarding this below is the link to it.

- Stack Exchange Query

# References

- [Wikipedia - Concept Study](#)
- [Youtube - Concept Study](#)
- [Blender 2.79b Documentation](#)
- [Models from Turbo Squid](#)
- [Classroom scene from Blender.org](#)