FOSSEE Summer Fellowship 2025

Report On

Models, 3d Animation in Blender 4.3.2

Submitted By

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Under the guidance of

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Acknowledgement

I would like to express my gratitude to **Prof. Kannan M. Moudgalya** whose vision of FOSSEE has enabled me to work on such a noble and creative endeavour, imparting the gift of comprehension to those that need it. I would like to thank my mentor **Mr. Khushalsingh K. Rajput, (FOCAL Lead and Sr. Software Engineering. FOSSEE, IIT Bombay).** If not for his quick-witted insight and mind-boggling creative suggestion, the animation would not have turned out to be as wonderful as they are now. He can understand the talent of students and give projects related to the student's talented topic. This may improve the quality of the project and gain a depth knowledge about the topics.

At last, I would like to take this opportunity to express my gratitude to the person who was instrumental for the conduction of this great programme. I show my greatest appreciation **to Prof. Kannan M. Moudgalya** for tremendous support throughout the fellowship.

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

With Regards,

Divyansh Somkuwar

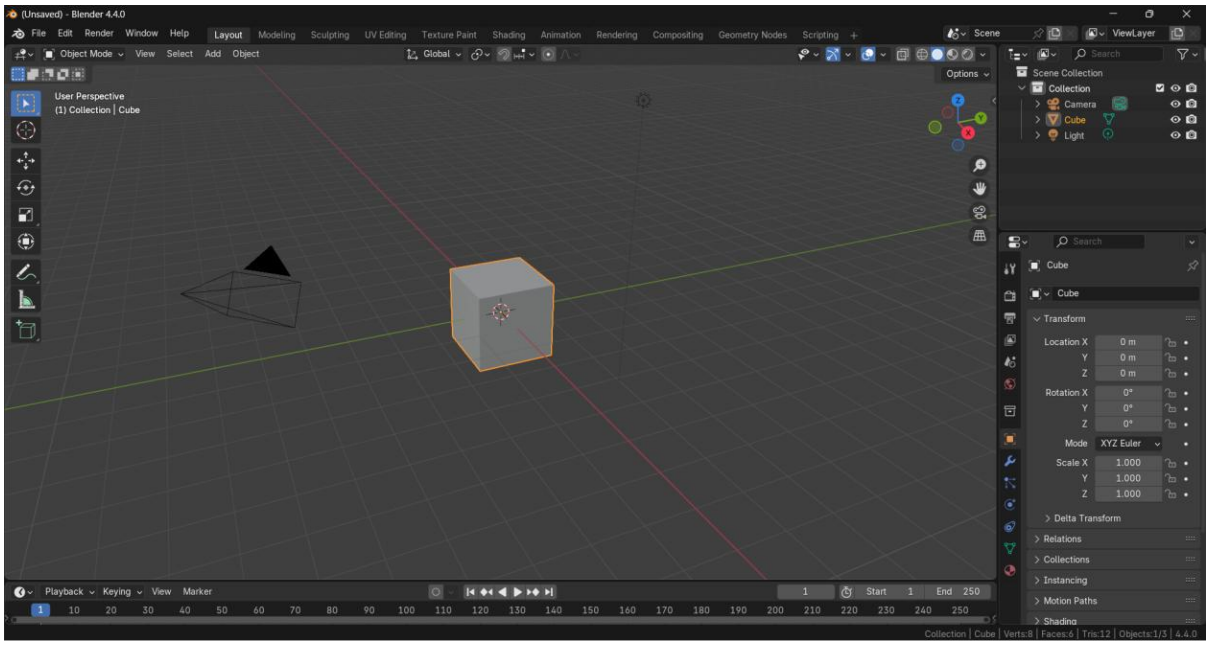
Contents

1 Introduction

1.1 About Blender

Blender is a free and open-source 3D computer graphics software that provides a complete pipeline for creating a wide range of digital content. It is widely used for producing animated films, visual effects, 3D printed models, video games, motion graphics, and interactive applications. The software includes powerful features such as 3D modelling, UV unwrapping, texturing, sculpting, rigging, animation, and rendering. In addition, Blender supports fluid, smoke, cloth, and particle simulations, as well as video editing, motion tracking, and compositing.

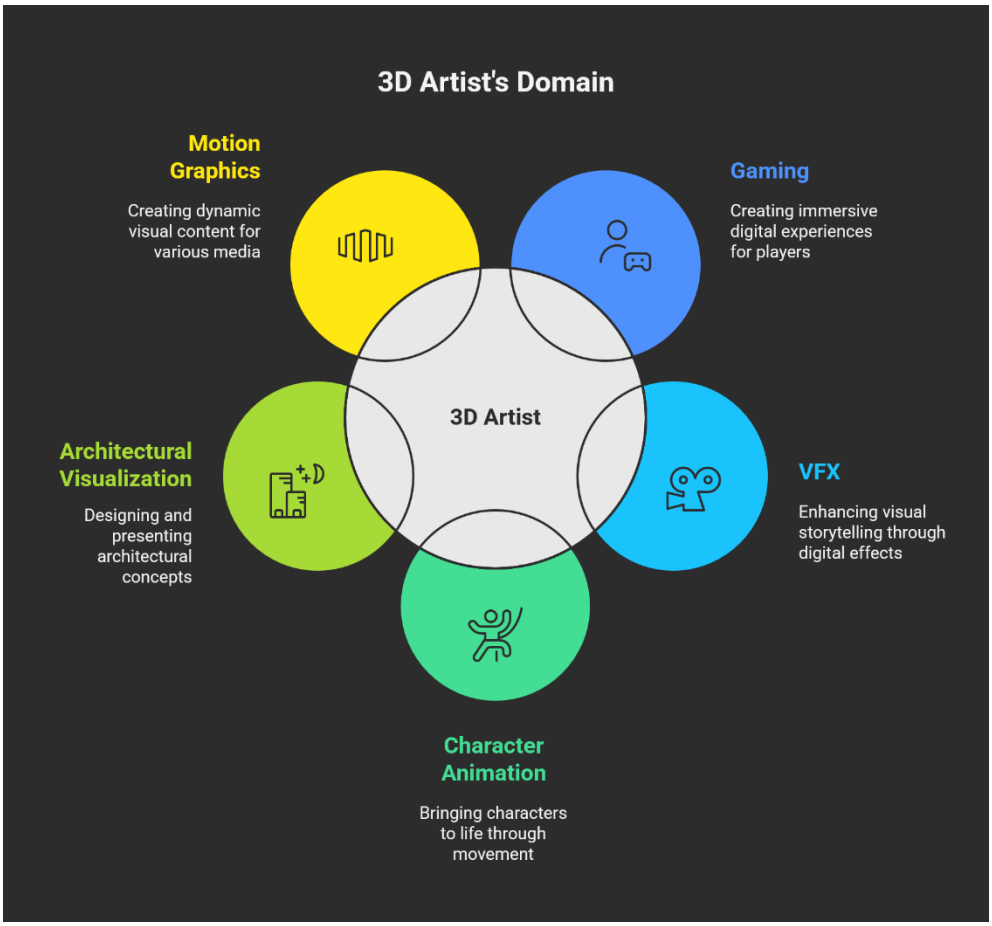
The projects ware created using Blender 4.4.0, taking advantage of both the Cycles and Eevee rendering engines depending on scene complexity and rendering needs. Cycles were used where high-quality ray tracing was necessary, while Eevee allowed for fast previews and real-time rendering. Both engines provided flexibility and efficiency during different phases of the project.



1.2 Skills Required to Be a 3D Artist

A 3D artist using Blender needs both creative and technical skills. Key tasks include modelling, texturing, shading, lighting, and rendering to create detailed and visually appealing assets. Sculpting, rigging, and animation are also essential for bringing characters and scenes to life.

Modern Blender artists often work with simulations like cloth and fluids, and procedural tools like Geometry Nodes. Skills in compositing, video editing, and camera movement further enhance storytelling. These abilities make them valuable in industries such as film, games, architecture, motion graphics, and visual effects.



2. Work Flow

2.1 Studying About Topics

First step to making a video is to read and study about the topic on which you will be making a tutorial. So that you don't pass any wrong or incorrect information to the viewers.

I used Wikipedia, YouTube, Instagram for inspiration, NCERT Books to collect information about the topics and get the idea of what I want to show to viewers to help them understand the concepts.

2.2 Warm Up Tasks

2.2.1 Bouncing Ball Animation

Description: Animated a ball falling from a height and bouncing multiple times before settling. The motion reflects natural gravity and energy loss.

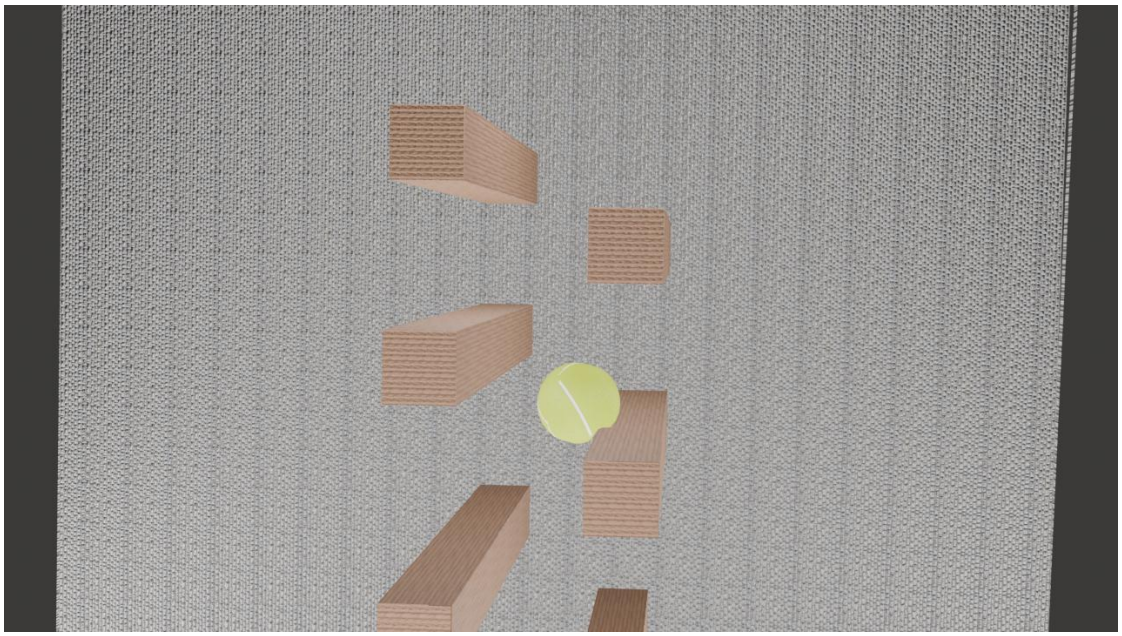
Key Techniques:

- Used a UV Sphere for the ball and a Plane as the ground.
- Applied location keyframes to animate the fall.
- Adjusted curves in the Graph Editor
- added squash and stretch on impact to enhance realism.
- Each bounce reduced in height to simulate damping.

Outcome:

Learned basic animation principles such as gravity, timing, and squash & stretch using Blender's keyframe tools.

Animation Link –
https://drive.google.com/file/d/146RUv7l7XHfNIn44RrQshArlIXDyZ4lU/view?usp=drive_link



2.2.2 JRS Portal Animation

Description: Created a short animation showing the user login process and dashboard interface of the JRS Portal.

Key Techniques:

- Modelled a desktop setup and portal screen
- Simulated user interaction using a simple armature rigs and constraints.
- Designed 2D UI using textured planes
- Synced camera motion and screen overlays
- Used keyframes to match actions with UI feedback

Outcome: Learned how to combine 2D UI with 3D animation. Improved skills in scene composition, character interaction, and UI walkthroughs.

Animation Link –
https://drive.google.com/file/d/1e_rTFQiYWbxbg6mpNFOyD8sFFfGk2xi3/view?usp=drive_link

2.3 Main Tasks

2.3.1 Working of a Mechanical Engine Animation

Description: Animated a 4-cylinder engine in Blender with pistons, crankshaft, and belt system. The motion follows the firing order 1-3-4-2, showing staggered piston cycles and rotational synchronization.

Key Techniques:

- Constraints for piston-crank motion
- Offset keyframes for firing order (1-3-4-2)
- Belt-pulley rotation using parenting
- 250-frame seamless loop
- Eevee rendering for smooth output

Outcome: Realistic, looped engine cycle with correct firing sequence for educational and mechanical visualization.

Animation Link –
https://drive.google.com/file/d/1hFg_C7j6oHewITAiKTuiHnk805_BUPcc/view?usp=drive_link

2.3.2 Newton's First Law of Motion

Description: The animation demonstrates Newton's First Law using a ball at rest that moves only when a wind force is applied.

Key Techniques: -

- Wind Field: Applied to simulate an external force acting on the object.
- Rigid Body Physics: Used to make the ball react naturally to forces and gravity.
- Step Model Design: Custom steps created to visualize vertical and horizontal motion.
- Cloth Simulation: Used for curtain movement, showing motion due to airflow.
- Camera Tracking: Smooth camera movement to focus on object behaviour dynamically.

Outcome**:** Visually explains inertia—objects remain at rest or in motion unless acted on by an external force.

Animation Link – https://drive.google.com/file/d/1K1oN8Eve9BOf-VhXB34gh2BSlSCl5JK7/view?usp=drive_link

2.3.3 Newton’s Second law of Motion

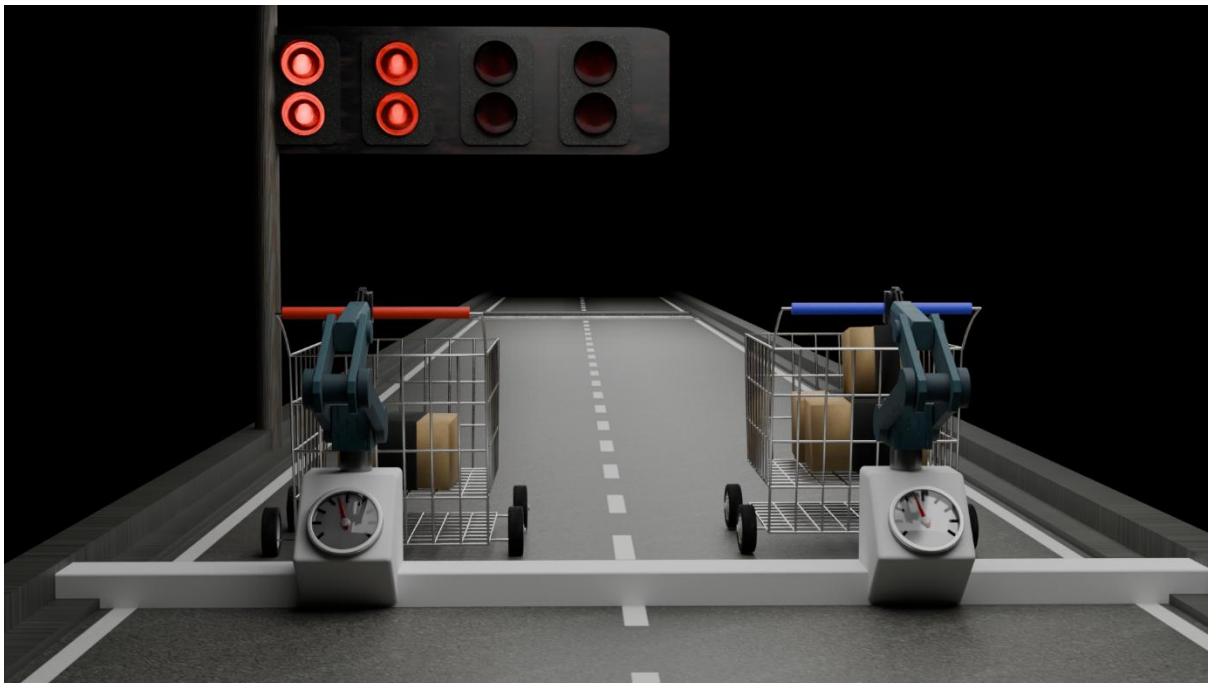
Description: This animation visually demonstrates Newton’s Second Law by showing two carts of different masses moving on a flat surface under the same applied force from a robotic arm.

Key Techniques:

- Physics-based motion using Blender’s rigid body simulation
- Use of a robotic arm to apply equal force
- On-screen labels and split-screen comparison
- Simplified props and timing panels for clarity

Outcome: Learners observe that heavier objects accelerate less under the same force, clearly reinforcing the concept:
(F = m × a — as mass increases, acceleration decreases**.)**

Animation Link – https://drive.google.com/file/d/1psIVGzwJLdV-8alfdg6Yp7aYQ63zP2u9/view?usp=drive_link



2.4 Animate Intro Video Tasks

2.4.1 Scene 2

Description: A visual triptych showing a student, an educator, and an artist in their creative spaces. The scene highlights learning, teaching, and creating as core elements of future-ready education.

Key Techniques:

- Characters posed to reflect real-life roles
- Custom assets: laptop desk, chalkboard, painting setup
- Targeted lighting for each frame to guide focus
- PBR materials for added realism and surface detail

Outcome: The scene emphasizes the interconnection of education and creativity, reinforcing ANIMATE 2025's vision of a collaborative, knowledge-driven future.

Animation Link –

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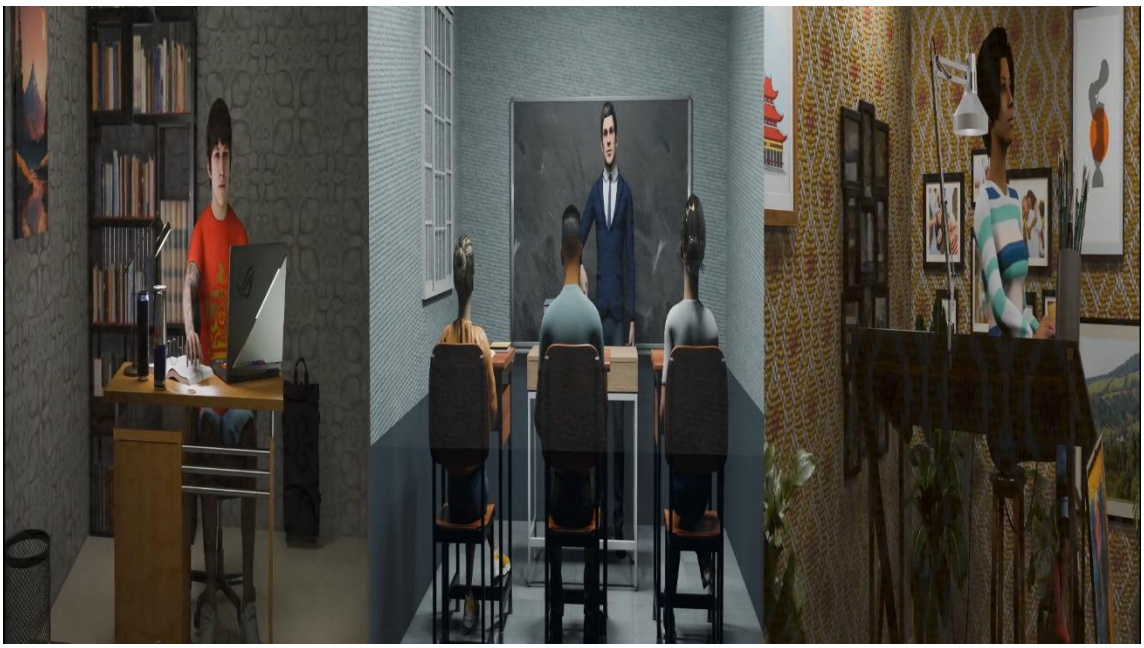


2.4.2 Scene 7

Description: An animator presents their digital work in a focused workspace, symbolizing online showcases and modern creative workflows in a connected, tech-driven world.

Key Techniques: -

- Character posed in a realistic working posture
- Custom desk setup with laptop, headphones, and keyboard
- Controlled lighting to create a studio-like mood
- PBR materials for surfaces and props to enhance realism

Outcome: The scene emphasizes digital creativity and remote presentation, echoing ANIMATE 2025's vision of future-ready, collaborative expression.

Animation Link –
https://drive.google.com/file/d/1EYBDgCwd6nqJUOd1OxBYUsNJKTwJVh1N/view?usp=drive_link

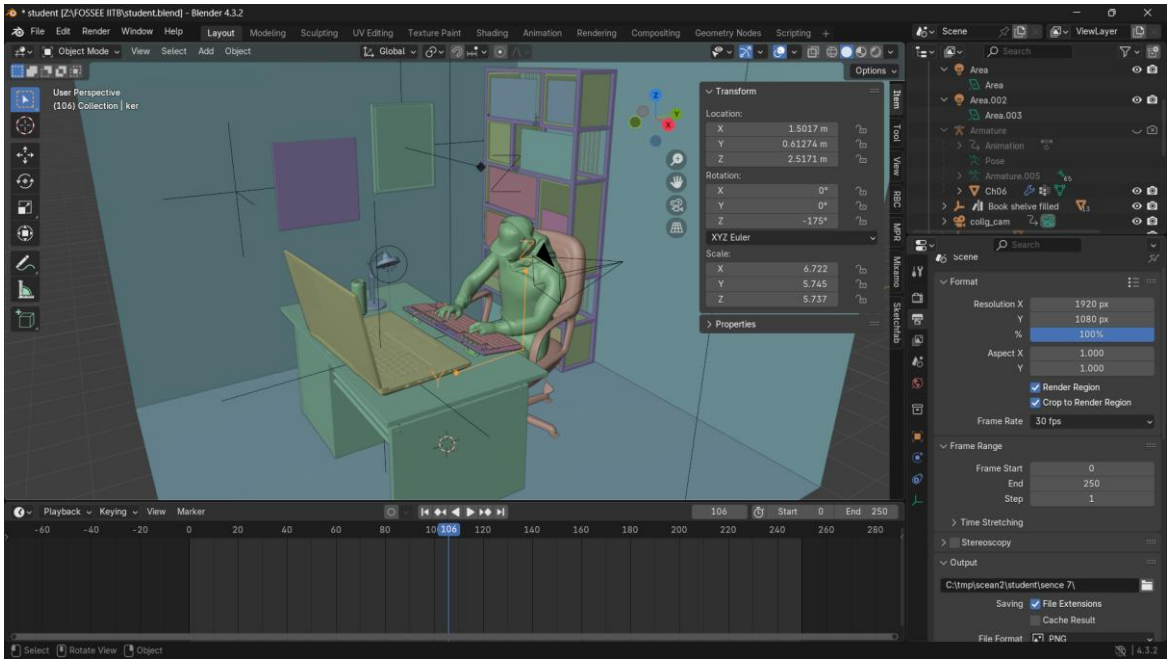
2.5 Animation and Creating Models

Animations are a sequence of images shown in rapid succession to create the illusion of continuous motion. In 3D graphics, animation brings static models to life through movement, timing, and transitions.

2.5.1 Modelling

Modelling is a fundamental process in computer graphics used to create 3D digital representations of objects or surfaces. Artists use specialized software to manipulate points in virtual space—called vertices—to build a mesh, which is a collection of interconnected vertices forming the shape of an object. These vertices are positioned within a 3D grid and connected to form polygonal shapes, usually triangles or quads. When combined, they define the surface and volume of the object.

Modelling often involves customizing polygon shapes with the help of modifiers like Solidify, Wave, Mirror, and Subdivision Surface. Empty objects may be used in conjunction with these modifiers to define motion along specific axes.



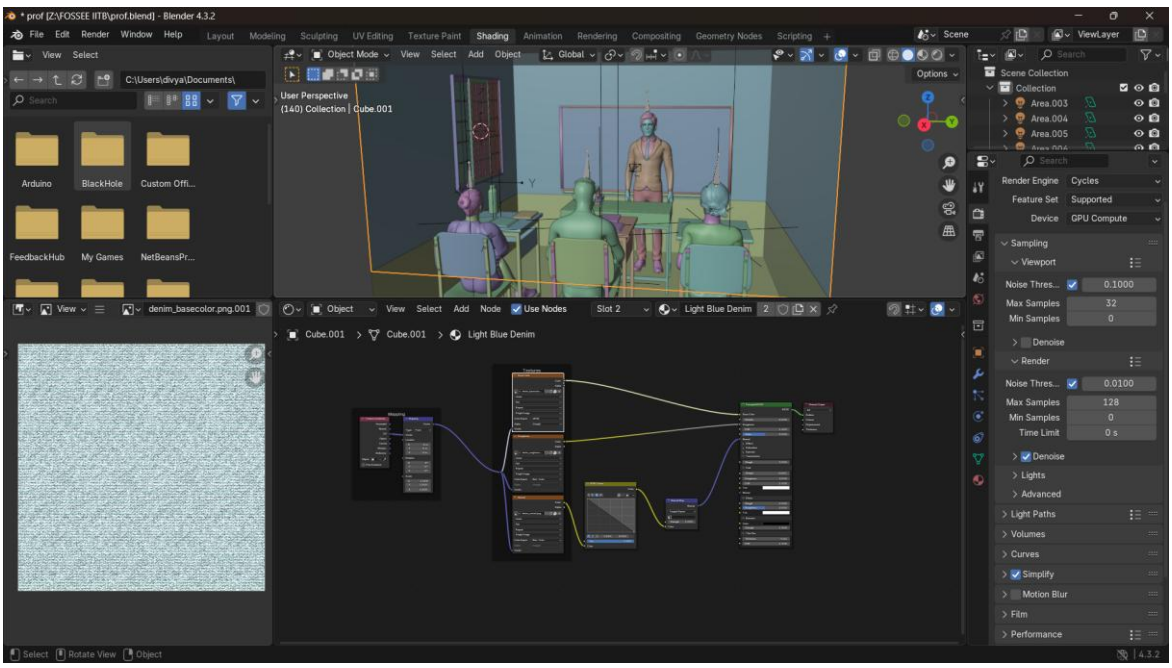
In many cases, reference images are used to guide polygon customization. Depending on the object, both hard surface modelling (for rigid, mechanical parts) and soft surface modelling (for organic, flexible shapes) are employed.

2.5.2 Texturing and Procedural Nodes

After the 3D model is complete, materials are applied to give it realistic appearance. This is a crucial step in achieving photorealism. In Blender, both Cycles and Eevee render engines are utilized, with extensive use of material nodes to define colour, reflectivity, roughness, and other surface properties.

In one part of the project, abstract environments and stylized elements were created using Blender's Geometry Nodes and modifiers, instead of traditional polygon modelling. Procedural setups were used to generate waveforms, terrain-like patterns, and particle-based effects, which were looped for visual interest.

Instead of realistic texture maps, procedural shaders with noise, gradients, and emission nodes were applied to achieve a vibrant, stylized look. These assets were integrated into animated loops with basic HDRI lighting setups to give depth and contrast to the scenes.



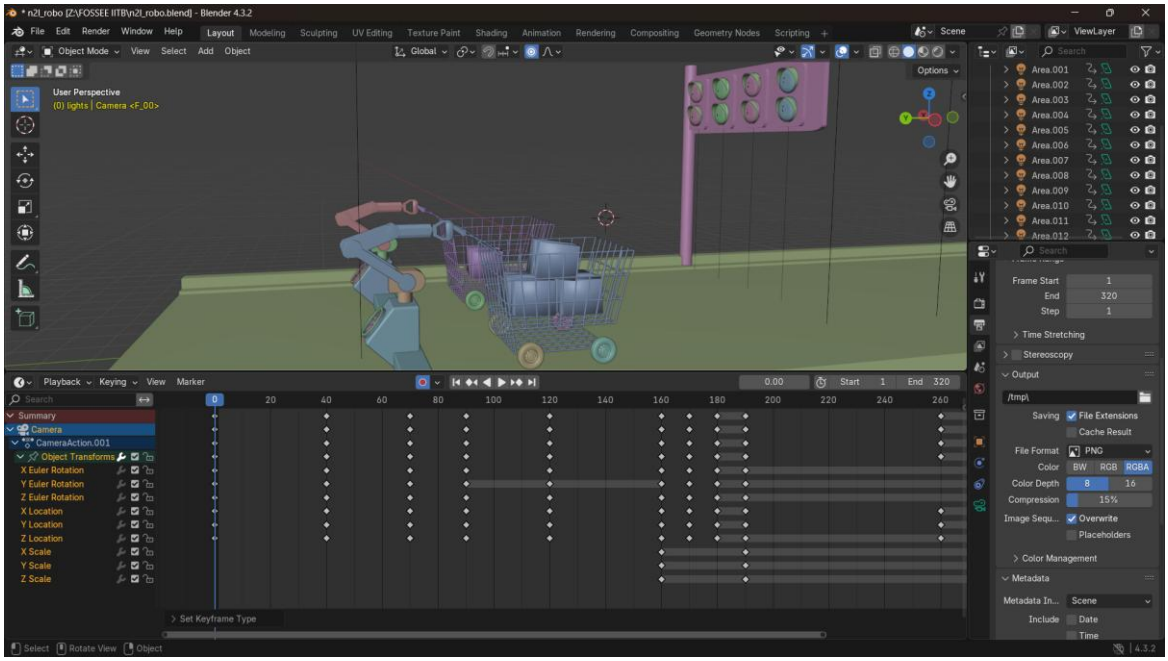
2.5.3 Animation

Animation involves moving objects or armatures (skeletal bones) across frames and adding keyframes to define their position at specific points in time. Tools like Graph Editor and Dope Sheet are used to fine-tune the speed and flow of animations.

Keyframes can be inserted through node editors and animation tabs in Blender. The Dope Sheet allows precise control over timing and movement paths. For instance, if an object is set to move along a circular path, the Graph Editor helps adjust its speed smoothly over time—something that isn't directly possible through simple keyframing.

2.5.4 Testing

Testing is the final check to ensure that the animation behaves as expected. It helps catch issues such as incorrect frame timing or material inconsistencies. Before presenting the animation or integrating it into a larger project, testing ensures that the visual experience—especially in VR or cinematic formats—delivers the intended effect to the viewer.



2.5.5 Rendering

Rendering is the process of generating a 2D or 3D image or animation from a scene using rendering engines. It is used extensively in architectural visualization, video games, movies, simulators, and special effects.

This step is typically the most time-consuming, as each frame must be rendered as an individual image, which are then compiled into a video sequence at a chosen frame rate (FPS).

Large-scale projects may not render efficiently on systems with limited GPU power. In such cases, Blender Render Farms—community-supported rendering services—can be used to significantly reduce render time and offload processing.

3. Issues Faced and Solutions

- **Bounce Timing Issues:**
  Early bouncing ball motion felt unrealistic.
  Solution: Refined Graph Editor curves and applied squash/stretch for realism.
- **UI Sync Problem:**
  Hand movements didn’t align with portal UI clicks.
  Solution: Used constraints and adjusted keyframes for better sync.
- **Slow Rendering:**
  High samples caused long render times.
  Solution: Used adaptive sampling, denoising, and lighter materials.
- **Scene Management:**
  Animate 2025 scenes became cluttered and hard to control.
  Solution: Organized with collections and linked files.
- **Physics Visualization Clarity:**
  Showing motion laws with simple objects was challenging.
  Solution: Used wind fields, labels, and clean environment to highlight concepts.

4. References

To Study

- Wikipedia – Concept Study
- YouTube – Concept Study (Animations, Physics, UI Design)
- Blender 4.3.2 Documentation – Software Reference
- NCERT Class 9 & 10 Science and Physics Textbooks – Scientific Concepts
- OpenGameArt.org – Free 3D Models and Texture Assets
- Physics Classroom – For Newton’s Laws and Inertia
- Blender Artists Forum – Community Help and Solutions
- Blender Stack Exchange – Problem Solving and Technique Clarification