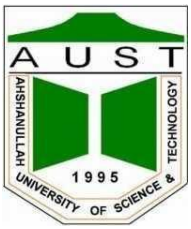
Ahsanullah University of Science & Technology
Department of Computer Science & Engineering



Houses from Outside

Computer Graphics Lab (CSE 4204)

Project Final Report

Submitted By:

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Project Requirements:

The primary objective of this project was to create a realistic 3D-rendered environment using Three.js, incorporating interactive and graphical elements to enhance visualization. The project required the implementation of custom shaders for realistic rendering, lighting effects to improve scene realism, and perspective projection for accurate depth perception. The scene had objects with individual textures, and animation effects were necessary to introduce movement and dynamics. Mouse and keyboard interactions were implemented to allow user control, including camera movement and texture switching. Additionally, the project included a background sky and a distant sun, along with an animated cloud model that flows naturally across the sky.

Software Platform:

- **Development Environment:** Visual Studio Code
- **3D Library:** Three.js
- **Rendering Engine:** WebGL
- **Programming Language:** JavaScript
- **Runtime Environment:** Node.js

Project Features:

The project incorporates the following features:

1. **3D Model Loading** – The building and cottage models were loaded and rendered with appropriate scaling and positioning using Three.js. This ensured a proper visual representation of the scene. Models were imported using GLTFLoader, and transformations were applied to align them correctly.

2. **Texture Mapping** – Custom textures were applied to walls, roofs, doors, windows, and the ground. Each object was assigned a separate texture to enhance realism and improve material differentiation. Textures were loaded using TextureLoader and mapped using MeshStandardMaterial.

3. **Lighting Implementation** – Three types of lights were implemented: ambient light for general illumination, directional light to simulate sunlight, and a rotating light source that dynamically moves around the building.

4. **Perspective Projection** – The scene was rendered using perspective projection, ensuring objects appeared proportionally smaller as they moved further away from the camera. This was achieved using a PerspectiveCamera with appropriate field of view settings.

5. **Mouse Interaction** – Users can click on the screen to change the small cottage's texture dynamically. This feature allows for variation in the environment and makes the scene more interactive. Event listeners were added to capture mouse clicks and swap textures randomly.

6. **Keyboard Interaction** – The camera can move around the houses using keyboard inputs. This allows users to navigate and explore different angles of the 3D scene. addEventListener was used to handle arrow key inputs and update camera movement accordingly.

7. **Animation** – The light source rotates around the building, simulating natural light movement throughout the scene. Animations were handled using the requestAnimationFrame loop.

8. **Custom Shaders** – Custom shaders were developed and applied to specific objects to enhance their rendering quality and material properties, making surfaces more visually appealing. Shaders were written in GLSL and applied using ShaderMaterial.

9. **Background Sky & Sun Model** – The sky and a distant sun were created within a single Node.js constructor, forming the environmental backdrop of the scene. The sun was positioned to simulate daylight conditions.

10. **Cloud Animation** – A cloud model was added and animated to flow across the sky, providing a realistic weather effect. This animation enhances the liveliness of the environment. Clouds were implemented using gltf models, setting their positions above the scene and using animation and conditions to make them flow.

#	Features	Status
1	3D Model Loading	Implemented
2	Texture Mapping	Implemented
3	Lighting Effects	Implemented
4	Mouse Interaction (Click to Change Texture)	Implemented
5	Keyboard Interaction (Move Camera)	Implemented
6	Animation (Rotating Light)	Implemented
7	Perspective Projection	Implemented
8	Custom Shaders	Implemented
9	Background Sky & Sun Model (Node.js Constructor)	Implemented
10	Cloud Animation	Implemented

Table 01: Project Feature Table

Snapshots:

Some snapshots of the project:

Figure 1: Overall front view of the project

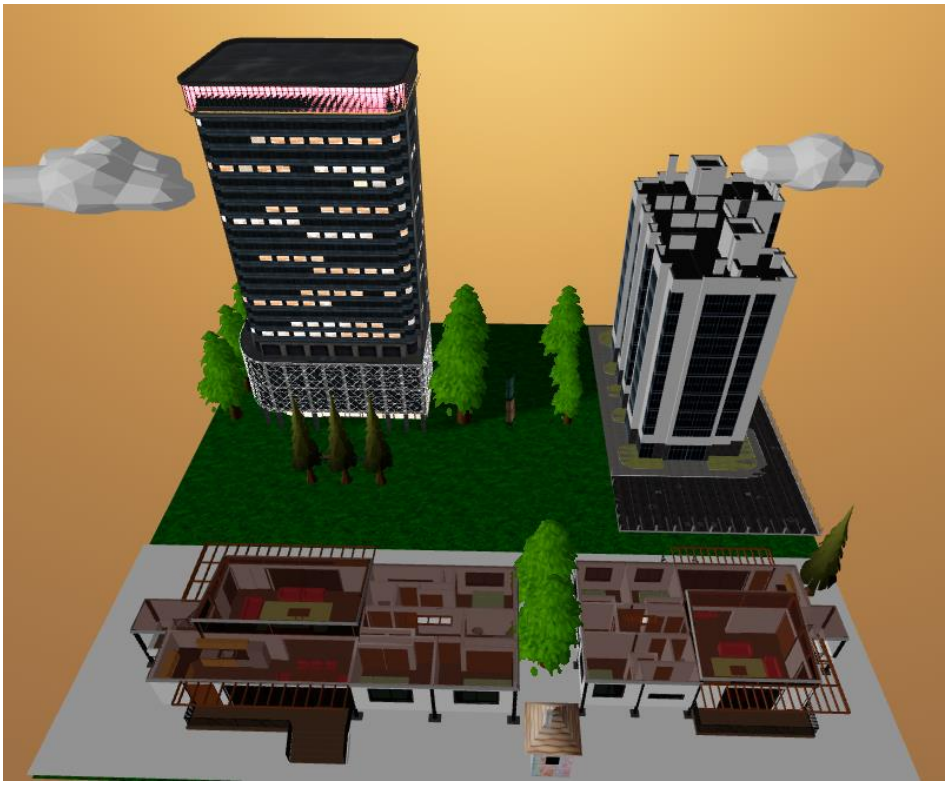

Figure 2: Top view of the project

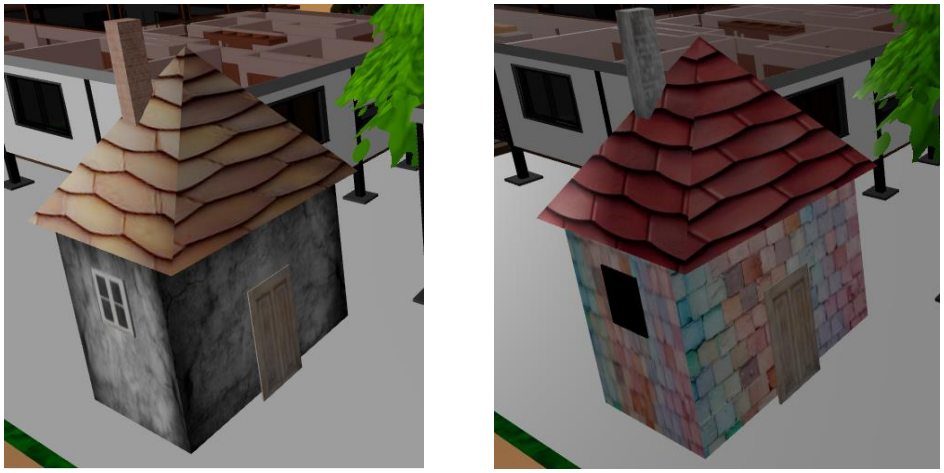

Figure 3: Texture change after mouse click

Figure 4: Camera Rotation using keyboard and perspective projection view

Contribution:

Both team members worked collaboratively to enhance the visual and interactive experience of the 3D scene, with Arijit focusing on lighting, shaders, and camera mechanics, while Nabila contributed to interactive textures, animations, and performance optimization.

Arijit Paul (20200204067):

- Loaded 3D models for the building and cottage and correctly scaled them for realistic proportions.

- Implemented lighting effects, including ambient, directional, and rotating lights around the building.
- Developed custom shaders to enhance material properties and rendering quality.
- Developed animation logic for rotating the light source around the building.
- Constructed the background sky and sun within a single Node.js constructor.
- Enhanced camera mechanics to provide more intuitive and responsive movement, improving overall navigation.

Nabila Rahman (20200204065):

- Added interactive texture changes for the cottage walls, doors, windows, and roofs.
- Implemented mouse click interactions for texture switching.
- Implemented keyboard-based camera movement to navigate around the houses.
- Ensured proper perspective projection for realistic depth perception.
- Modeled and implemented animated clouds that dynamically move in the sky.
- Optimized shadow rendering to reduce performance impact while maintaining visual quality.

Future Work:

- **Enhance Model Interactivity:** Implement click-based animations instead of just texture changes.
- **Add Dynamic Weather Effects:** Introduce rain, snow, or sunlight effects to improve realism.
- **Optimize Performance Further:** Reduce texture load times and improve frame rates.
- **Introduce Day-Night Cycle:** Implement a gradual time transition with changing lighting and shadows for added realism.