CSE 4208: Computer Graphics Laboratory

Modern Duplex Home with Yard
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Contents

Introduction

The project, *Modern Duplex Home with Yard,* focuses on the development of a realistic 3D model of a modern duplex house. It incorporates architectural accuracy, advanced materials, and lighting techniques. The aim is to provide a visually appealing and scalable design that includes essential features such as textured walls, floors, and a functional yard with a garden.

Objective

The primary objectives of this project include:

1. Developing a 3D model of a modern duplex house with realistic architectural details.
2. Incorporating a functional yard featuring a garden for aesthetic and practical realism.
3. Applying high-quality textures to walls, floors, and roofs for enhanced visual fidelity.
4. Constructing functional and precisely aligned stairs.
5. Employing advanced lighting techniques to improve the visual experience.
6. Designing the model for scalability and potential future modifications.

Project Idea

The idea behind the *Modern Duplex Home with Yard* project is to create a detailed 3D architectural visualization of a modern duplex home integrated with a functional outdoor environment. This project aims to bridge the gap between design aesthetics and realistic rendering, providing a comprehensive model that simulates a real-world structure.

The concept revolves around designing a sophisticated duplex home with the following features:

1. **Architectural Detailing**:
   - o Accurate modeling of structural components such as walls, roofs, floors, and staircases to mimic modern duplex designs.
   - o Functional layouts, including living spaces, bedrooms, kitchens, and washrooms, to reflect realistic living standards.
2. **Outdoor Space Integration**:
   - o A well-designed yard featuring a landscaped garden that enhances the visual appeal and adds functionality to the outdoor space.
   - o A swimming pool strategically placed to complement the home's luxurious aesthetic.
3. **Realism Through Textures and Lighting**:
   - o Application of high-resolution textures to walls, floors, and roofs to provide a realistic look and feel.
   - o Advanced lighting techniques to simulate natural sunlight and artificial illumination, ensuring a visually engaging experience. 4. **Scalability for Future Enhancements**:
   - o The design accommodates future modifications, such as expanding the layout or adding new features, making the project flexible and adaptable.

Project Overview

The *Modern Duplex Home with Yard* project focuses on designing and implementing a realistic 3D model of a modern duplex house with detailed architectural features and a functional outdoor environment. The project combines advanced computer graphics techniques with practical architectural principles to create an immersive and visually appealing model.

Key highlights of the project include:

1. **Comprehensive 3D Modeling**
   - o A detailed duplex home design featuring various functional areas, such as a drawing room, two types of bedrooms, kitchen, and washroom.
   - o Precise architectural alignment and proportions to ensure the model's

realism.

2. **Functional Outdoor Environment**
   - Integration of a landscaped yard with a swimming pool and a garden, adding luxury and aesthetic value to the design.
   - Attention to environmental elements to create a harmonious indoor outdoor balance.
3. **High-Quality Visuals**
   - Application of realistic textures for all structural elements, including walls, floors, roofs, and stairs.
   - Use of advanced lighting techniques to enhance the overall visual experience by simulating natural and artificial light sources.
4. **Focus on Scalability and Adaptability**
   - The model is designed to be scalable, allowing for future modifications and expansions as needed.
   - This adaptability ensures the project remains relevant for applications in architectural visualization and virtual environments.
5. **Practical Applications**
   - The project demonstrates how 3D modeling can be applied to architectural design, real estate visualization, and interactive virtual tours.

The *Modern Duplex Home with Yard* serves as a proof of concept for leveraging 3D technologies in creating realistic and practical design solutions. Through this project, the aim is to showcase the potential of computer graphics in delivering immersive experiences that are both visually stunning and functionally sound.

Methodology

1 Keyboard Functionality

The project implements extensive keyboard functionality to allow users to interact with and control various elements of the 3D model in real-time. The functionality is enabled using GLFW's key input handling system. Below is a detailed breakdown of the implemented keyboard controls:

1. Camera Movement

·**W**: Move the camera forward.
·**S**: Move the camera backward.
·**A**: Move the camera left.
·**D**: Move the camera right.

·**E**: Move the camera up.
·**R**: Move the camera down.
·**T**: Adjust the camera position upward along a specific axis. ·**F**: Adjust the camera position downward along a specific axis. ·**U**: Rotate the camera left around the Y-axis.
·**H**: Rotate the camera right around the Y-axis.
·**I**: Rotate the camera left around the R-axis.
·**J**: Rotate the camera right around the R-axis.

2. Model Translation

·**O**: Translate the model along the Z-axis (move it farther).

3. Model Rotation

·**X**: Rotate the model around the X-axis.
·**Y**: Rotate the model around the Y-axis.
·**Z**: Rotate the model around the Z-axis.

4. Door Controls

·**1**: Open the front door incrementally (up to a maximum angle of 70°). · **2**: Close the front door incrementally (down to 0°).
·**3**: Open the back door incrementally (up to 80°).
·**4**: Close the back door incrementally (down to 0°).
·**5**: Open the bathroom door (translate incrementally within the maximum limit).
·**6**: Close the bathroom door (translate incrementally within the minimum limit).

5. Fan Rotation

· **0**: Increase the rotation speed of the fan by 5° with each press.

6. Light Controls

· **7**: Turn on ambient lighting and disable diffuse and specular lighting for all
lights.
· **8**: Enable diffuse lighting and disable ambient and specular lighting. · **K**:
Enable specular lighting while turning off ambient and diffuse lighting. · **L**:
Turn on all types of lighting (ambient, diffuse, and specular) for all lights.

7. Individual Light Controls

· **C**: Turn on specific room lights (drawing, bedroom 1, dining, bedroom 2,
bathroom).
· **V**: Turn off specific room lights.
· **B**: Turn on point light 3.
· **N**: Turn off point light 3.
· **M**: Turn on point light 1.
· **P**: Turn off point light 1.

These keyboard functionalities provide users with the ability to:

· Navigate through the 3D model using camera controls.
· Modify the model's orientation and position dynamically.
· Interact with environmental elements, such as doors and fans. ·
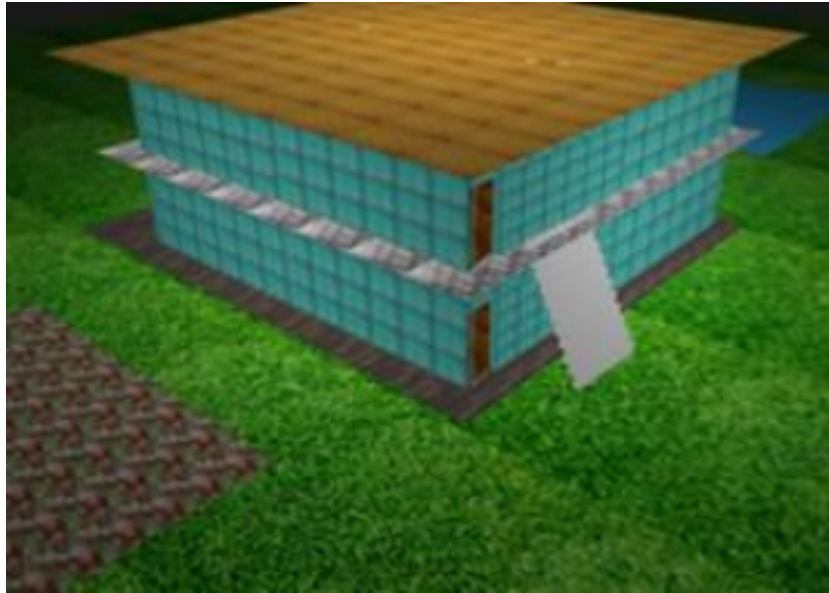Adjust lighting settings to visualize different lighting conditions.

This interactive control scheme ensures a rich and immersive user experience
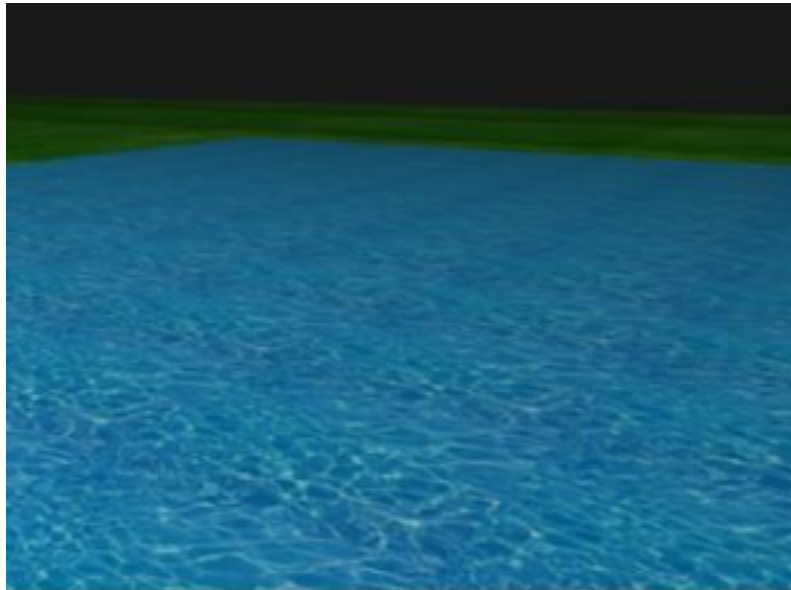while exploring and interacting with the 3D environment.

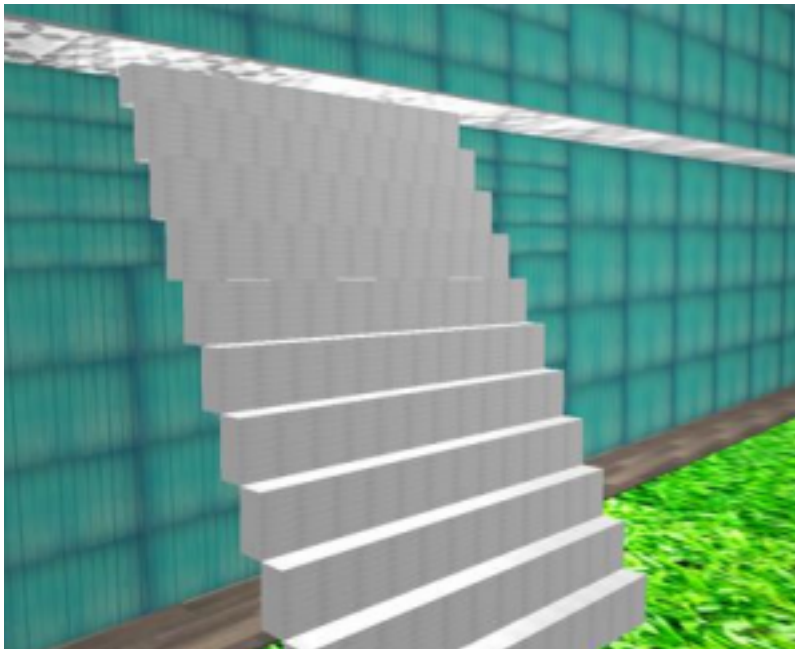# Features
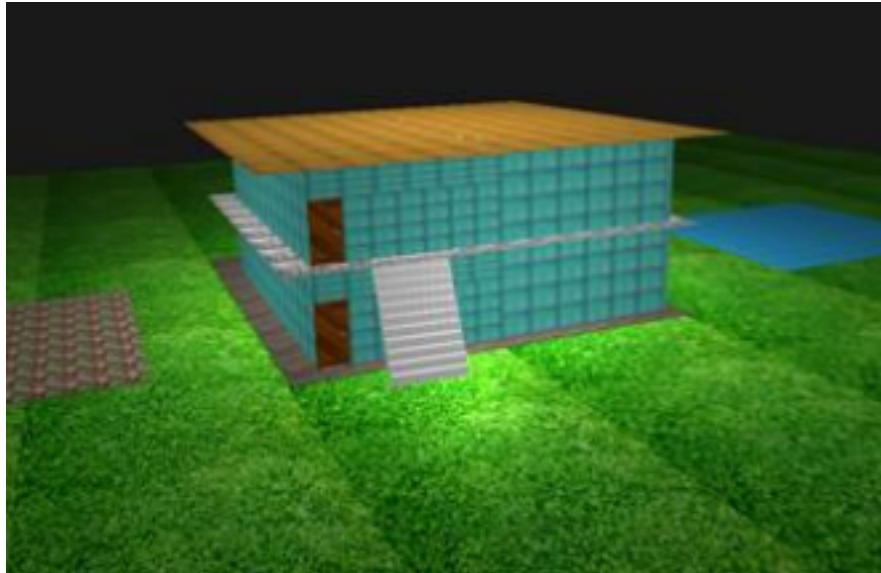
Figure 1: Bird view

Figure 2: Bird view 2
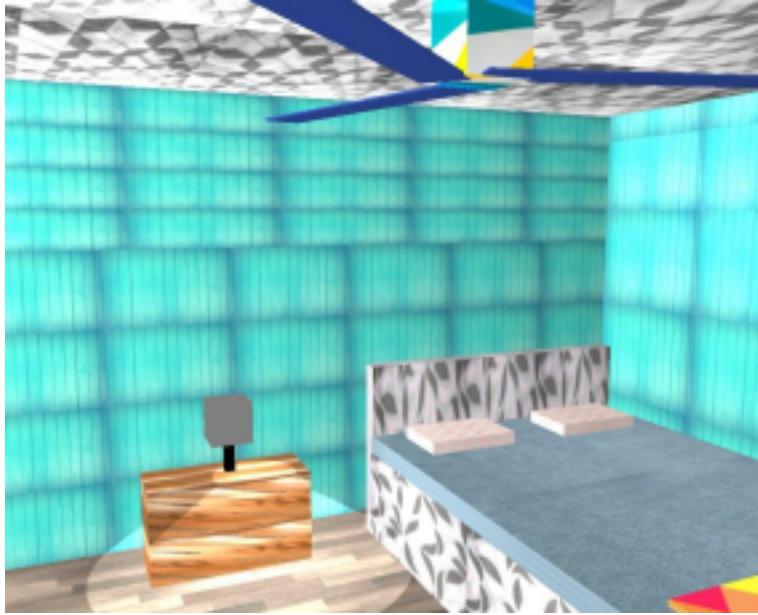
Figure 3: Pool

Figure 4: Garden

Figure 5: Stairs

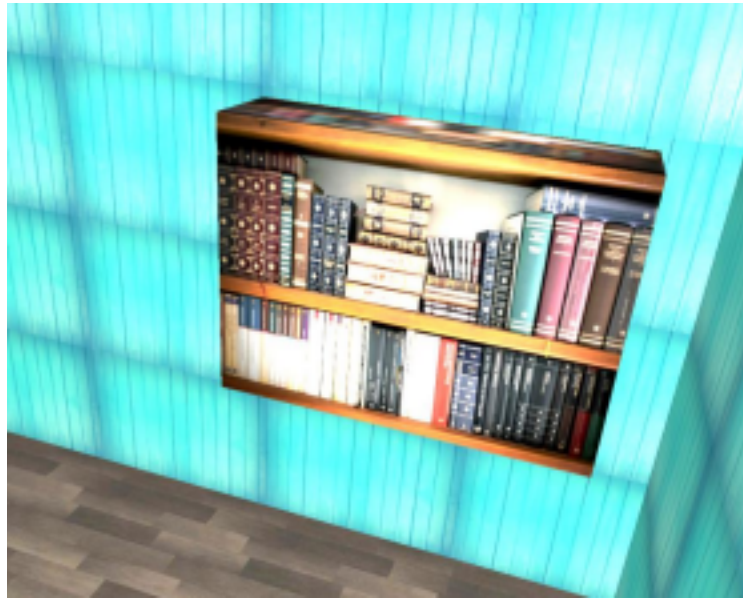*Figure 6: Drawing room*

Figure 7: Bed room type 1

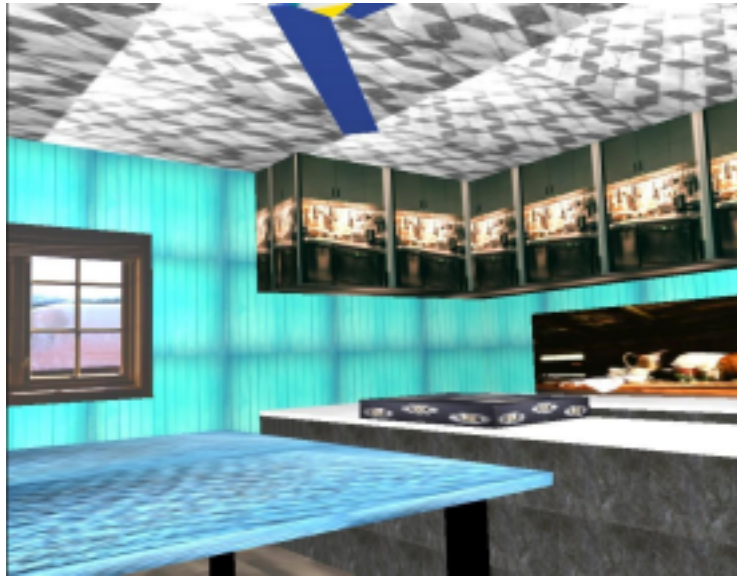*Figure 8: Bed Room type 1 view 2*

Figure 9: Bed room type 2 view 1

Figure 10: Book Shelf

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Figure 11: Kitchen view 1

Figure 12: Kitchen view 2

Figure 13: Kitchen chair and table view 3

Figure 14: Washroom with a white bucket

Discussion

The *Modern Duplex Home with Yard* project showcases the effective use of OpenGL for creating a realistic and interactive 3D architectural model. The inclusion of features such as a landscaped yard, swimming pool, and functional doors highlights the emphasis on realism and attention to detail. The use of high quality textures, precise alignment, and advanced lighting techniques further enhances the visual appeal of the model, making it suitable for architectural visualization and virtual walkthroughs. The project also integrates interactive controls, allowing users to explore and manipulate the environment using keyboard inputs, adding to the model's usability and engagement

Conclusion

The *Modern Duplex Home with Yard* project demonstrates the potential of OpenGL in creating immersive 3D architectural visualizations. By combining detailed modeling, interactive controls, and realistic lighting, the project offers a comprehensive solution for showcasing modern architectural designs. The flexibility and scalability of the model ensure its adaptability for future modifications, making it a valuable tool for real estate visualization, virtual tours, and design presentations. Overall, the project serves as a testament to the capabilities of computer graphics in delivering realistic and engaging user experiences.

References

[1] Demko, Stephen, Laurie Hodges, and Bruce Naylor. "Construction of fractal objects with iterated function systems." Proceedings of the 12th annual conference on Computer graphics and interactive techniques. 1985.

[2] Farin, Gerald. "Class a Bézier curves." Computer aided geometric design 23.7 (2006): 573-581.

[3] OpenGL tutorial(https://learnopengl.com/)