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Group: 08

FINAL PROJECT 2026-1

User Manual

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1 Introduction

This manual describes the interactions available in the virtual environment recreated with OpenGL, based on the series "Phineas and Ferb". The scene includes a house with multiple interactive elements that can be controlled via the keyboard, offering an immersive experience in the world of these animated characters.

2 Project Objectives

- Create an interactive 3D simulation of the Phineas and Ferb environment.
- Implement a kinematic animation system for various objects in the scene.
- Develop a dynamic day/night cycle that affects global lighting.
- Provide an intuitive user experience through simple controls.
- Demonstrate the use of advanced computer graphics techniques.
- Offer an educational platform for learning OpenGL and 3D development.

3 Technologies Used

- **Programming Language**: C++ 17
- **Graphics API**: OpenGL 4.0
- **Auxiliary Libraries**:
  - GLFW: Window and input management
  - GLEW: OpenGL Extension
  - GLM: Graphics mathematics
  - Assimp: 3D model importation
  - stb_image: Texture loading
- **Modeling Software**: Autodesk Maya (educational version)
- **Audio System**: Windows API for sound playback
- **Model Format**: .obj (Wavefront)
- **Textures**: PNG, JPG, and HDR formats

4 Installation and Execution

1. Ensure you have Windows 10 or higher installed.
2. Verify that your graphics card supports OpenGL 4.0.
3. Run the "ProyectoFinal.exe" file.
4. Wait for all resources to load (this may take a few seconds).
5. Once the scene is loaded, you can begin interacting.

5 Interaction System

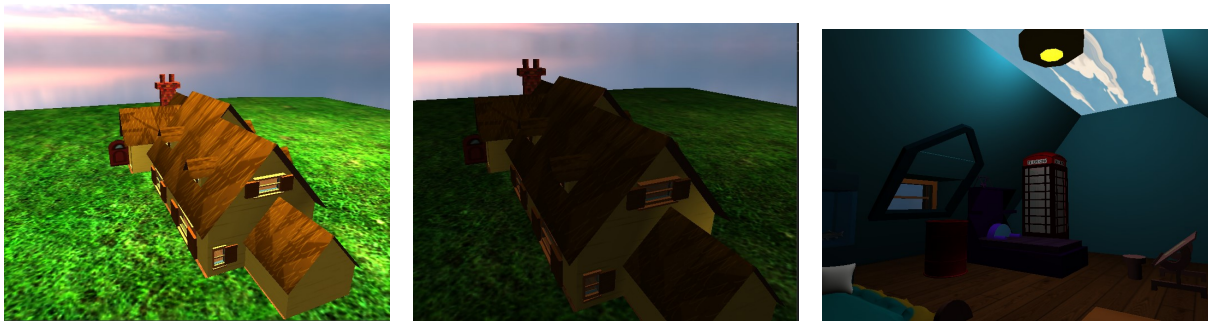
5.1 Navigation Controls

- **W / Up Arrow**: Move camera forward
- **S / Down Arrow**: Move camera backward
- **A / Left Arrow**: Move camera left
- **D / Right Arrow**: Move camera right
- **Mouse**: Control view direction (look around)
- **ESC**: Exit the application

5.2 Animation Controls

5.2.1 Day/Night Cycle (Key 1)

- **Function**: Activates/deactivates sun animation and day/night cycle.
- **Behavior**:
  - The sun completes a full cycle every 60 seconds.
  - Lighting automatically changes between day and night.
  - During the day: intense natural sunlight.
  - During the night: Phineas's room lamp turns on automatically.
  - Ambient lighting adjusts progressively.



(a) Noon - Sun at the highest point

(b) Sunrise/Sunset - Sun on the horizon

(c) Night - Artificial lighting activated

Figure 1: Complete day/night cycle with different sun states

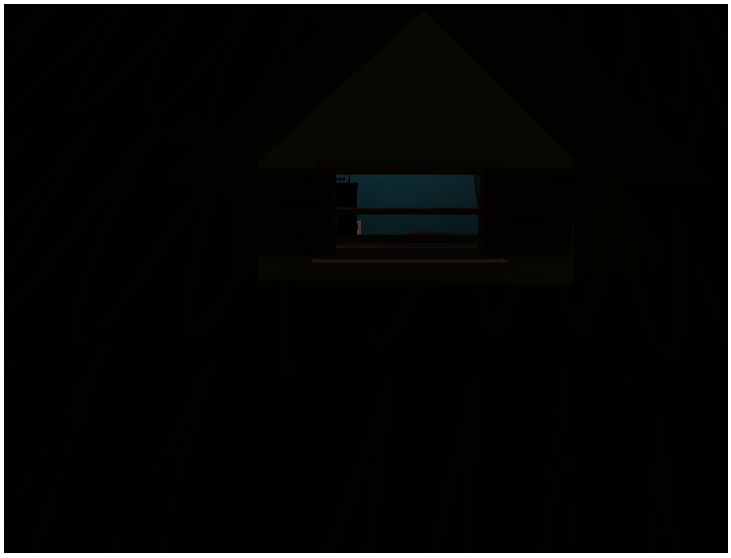
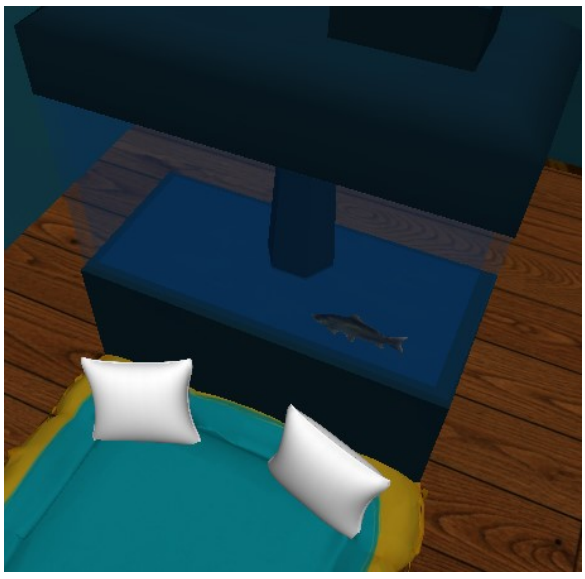


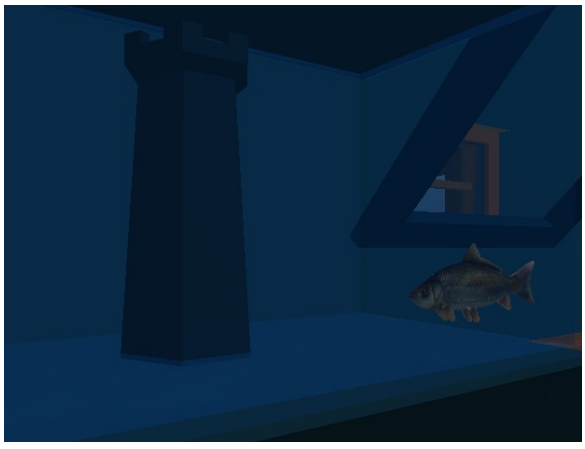
Figure 2: Night view showing Phineas's lamp turned on and the door open

5.2.2 Fish Swimming (Key 2)

- **Function**: Activates/deactivates the fish animation in the tank.
- **Behavior**:
  - The fish swims horizontally in the tank continuously.
  - It performs a 180-degree turn every 5 seconds.
  - The fish's tail moves with a natural undulating motion.
  - The animation combines translation, rotation, and fin movement.



(a) Fish swimming in one direction

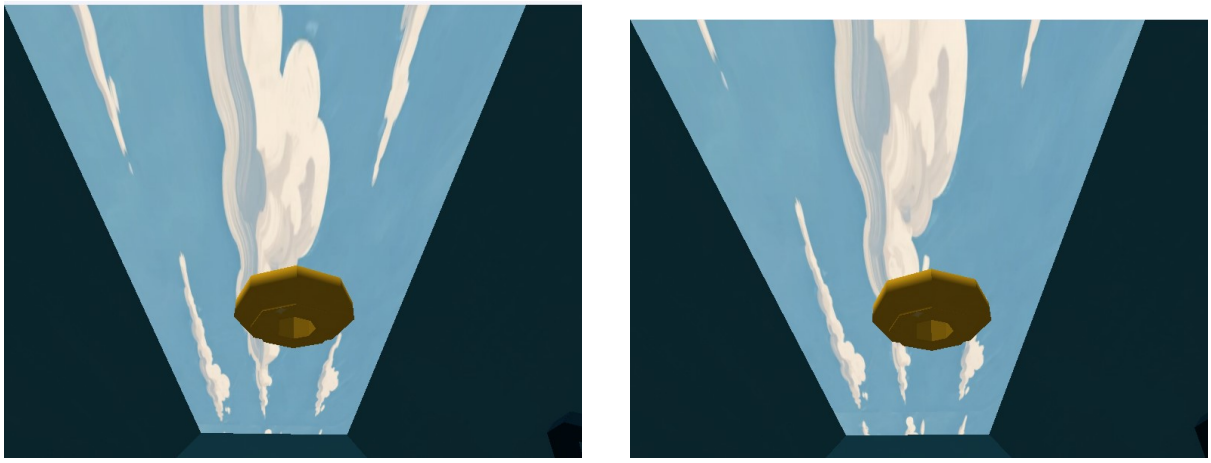


(b) Fish performing a 180-degree turn

Figure 3: Fish animation in the tank

5.2.3 Moving Clouds (Key 3)

- **Function**: Activates/deactivates cloud movement on the ceiling.
- **Behavior**:
  - Clouds move continuously across the room's ceiling.
  - The animation is performed via shaders on the GPU.
  - The effect simulates clouds drifting smoothly.



(a) Initial cloud position (b) Clouds after movement

Figure 4: Cloud animation on Phineas's room ceiling

5.2.4 Newton's Cradle (Key 4)

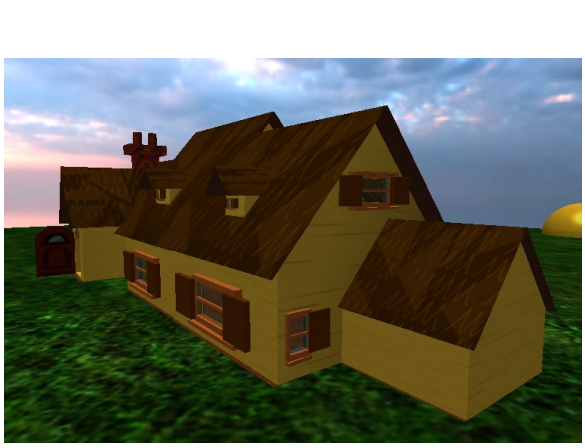
- **Function**: Activates/deactivates the pendulum movement.
- **Behavior**:
  - The pendulum spheres swing in a characteristic pattern.
  - An impact sound plays when changing phases.
  - The central spheres have a more subtle movement.
  - The animation follows a predefined kinematic pattern.

(a) Pendulum at rest (deactivated) (b) Initial movement phase (c) Intermediate movement phase

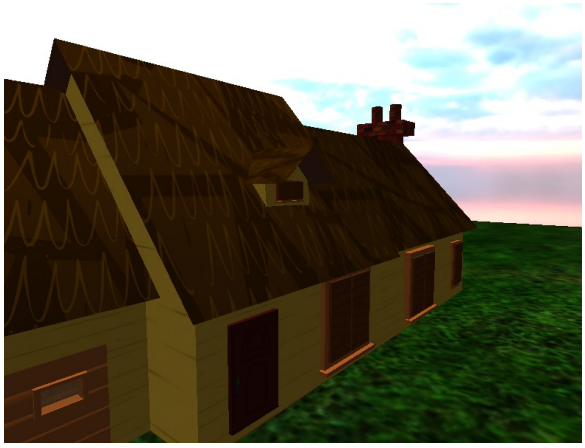
Figure 5: States of Newton's Cradle

5.2.5 Curtains and Doors (Key 5)

- **Function**: Controls all curtains and doors simultaneously.
- **Behavior**:
  - Toggles between open and closed state with each press.
  - Affects 6 pairs of curtains in different orientations.
  - Controls 3 different doors in the house.
  - Curtains slide smoothly to the sides.
  - Doors rotate on their hinges.

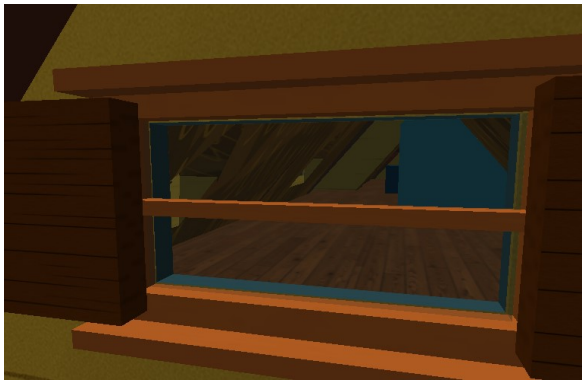


(a) Curtains and doors open



(b) Curtains and doors closed

Figure 6: States of curtains and doors



(a) Transparency effect on windows (view 1)

(b) Transparency effect on windows (view 2)

Figure 7: Realistic transparency on the house windows

6 Scene Description

6.1 Main Areas

- **House Exterior**: Replica of Phineas and Ferb's house.

- **Phineas and Ferb's Room**: Main room with inventions and projects.
- **Candace's Room**: Older sister's room with characteristic elements.
- **Common Areas**: Hallways and shared spaces.

6.2 Interactive Objects

- Main house with multiple rooms.
- Fish tank with animated fish.
- Functional Newton's Cradle.
- Dynamic lighting system.
- Sliding curtains.
- Rotating doors.
- Dynamic sky with HDR dome.
- Furniture and objects characteristic of the series.

6.3 Materials and Visual Effects

- **Translucent Glass**: Fish tank and booth with realistic transparency.
- **Shiny Metals**: Barrel and pendulum structure with high gloss.
- **Matte Materials**: Furniture and walls with non-reflective finish.
- **Dynamic Lighting**: Automatic changes between daylight and night light.
- **HDR Textures**: High dynamic range sky.
- **Custom Shaders**: Advanced visual effects.

7 Technical Requirements

- **Operating System**: Windows 10 or higher.
- **Graphics Card**: Compatible with OpenGL 4.0.
- **RAM**: 8 GB minimum recommended.
- **Storage**: 500 MB free space.
- **Input**: Keyboard and mouse.
- **Sound**: Windows-compatible audio card.

8 Controls Summary

Key	Function
1	Activate/Deactivate day/night cycle
2	Activate/Deactivate fish swimming
3	Activate/Deactivate cloud movement
4	Activate/Deactivate Newton's Cradle
5	Open/Close curtains and doors
W/A/S/D	Camera movement
Arrows	Alternative camera movement
Mouse	View control
ESC	Exit application

Table 1: Virtual environment controls summary

9 Additional Notes

- All animations can be activated/deactivated independently.
- State changes are shown in the application console.
- The camera offers free first-person movement.
- The day/night cycle automatically affects all light sources.
- Transparency effects are realistic and adjustable.
- The project is optimized for real-time execution.
- Resources are loaded at the start of the application.

10 Troubleshooting

- **Application does not start**: Verify that your graphics card supports OpenGL 4.0.
- **Textures do not load**: Ensure all files are in the correct folder.
- **Low performance**: Close other applications to free up resources.
- **No sound**: Verify Windows audio settings.