


Cat and Mouse - Chasing Game!

Computer Graphics Project Documentation

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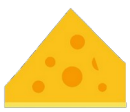

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1 Introduction

This document details the implementation of “Cat and Mouse - Chasing Game!”, a 2D maze game developed using C++ and the OpenGL Utility Toolkit (GLUT). The game features a player-controlled mouse navigating through various levels, collecting cheese pieces while being pursued by an AI-controlled cat. Key elements include dynamic difficulty scaling, collectible power-ups, multiple maze layouts, and a clear game progression system with distinct game states. The primary objective was to apply fundamental computer graphics concepts to create an interactive and engaging game experience.

2 Game Features

The game incorporates the following key features:

- **Core Gameplay:** Player controls a mouse to collect all cheese pieces on a level while avoiding a chasing cat.
- **Custom Sprites:** Unique, custom-designed sprites for the player (mouse), opponent (cat), cheese, and power-ups, drawn using OpenGL primitives. The initial visual design for characters was aided by an external shape-drawing tool that exported OpenGL primitive code, which was then integrated and transformed within the game.
- **Maze Navigation:** Movement within a 2D grid-based maze, including a tunnel feature for screen wrapping.
- **Rounded Wall Aesthetics:** Walls are rendered with a smooth, rounded appearance with outlines.
- **Multiple Levels:** Three distinct, pre-designed maze layouts providing varied challenges.
- **AI Opponent:** The cat utilizes a Breadth-First Search (BFS) algorithm to find and pursue the shortest path to the player.
- **Dynamic Difficulty:** The cat’s speed increases progressively as the player collects more cheese on each level, following a non-linear curve.
- **Power-up System:** A ”Cat Slowdown” power-up spawns randomly, which, when collected, temporarily reduces the cat’s speed.
- **Game States:** Comprehensive state management including a Start Menu, Playing, Paused, Game Over, Level Cleared, and Final Win screens.
- **On-Screen HUD:** Displays current level, total accumulated score, and the number of cheese pieces remaining on the current level.
- **User Controls:** Standard WASD for movement, ’P’ to pause/resume, ’R’ to reset the game, and ESC to quit.
- **Visual Feedback:** Includes a sparkling animation for power-ups and distinct screen overlays for different game states.


3 Game Design & Implementation Details

3.1 Maze Design & Levels

The game world is structured as a 23x23 grid. Three distinct maze layouts (`layout1`, `layout2`, `layout3`) are defined within the `initMaze` function. These layouts use integer codes: ‘1‘ for walls, ‘0‘ for traversable paths, and ‘3‘ for special path tiles where items like cheese or power-ups are not allowed to spawn (though they are visually identical to paths). A tunnel feature on row 11 allows horizontal wrapping. The `currentLevel` variable tracks progression, and `initMaze(currentLevel)` loads the appropriate layout.

3.2 Characters & Sprites

Custom sprites were designed for game entities and are rendered using OpenGL primitives. The initial visual design for characters was aided by an external shape-drawing tool that exported OpenGL primitive code. This code was then integrated into custom drawing functions (e.g., `drawCustomMouse`, `drawCustomCat`) where OpenGL transformations (`glPushMatrix`, `glPopMatrix`, `glTranslatef`, `glScalef`) are applied to position and scale them correctly within the game grid.

Note: An external tool was utilized for the initial design of character shapes, which exported basic OpenGL drawing commands. These commands were then integrated and transformed within the game’s C++ code.

3.2.1 Player (Mouse)

The player controls the mouse, aiming to collect all cheese pieces.

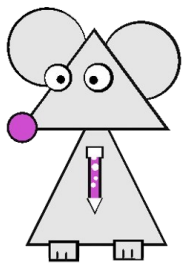

Figure 1: The player-controlled Mouse sprite, composed of several geometric primitives.

3.2.2 Opponent (Cat)

The cat is AI-controlled, using BFS to find the shortest path to the player.

Figure 2: The AI-controlled Cat sprite, also constructed from basic shapes.

3.3 Collectibles & Power-ups

3.3.1 Cheese

The primary objective: collect all cheese pieces to advance to the next level.

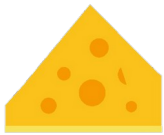

Figure 3: A cheese collectible. Collecting all cheese pieces completes the level.

3.3.2 Cat Slowdown Power-up

A blue, sparkling item that temporarily slows the cat down, giving the player an advantage.

Figure 4: The Cat Slowdown power-up item, visually indicated by a sparkling effect.

3.4 Game Mechanics

3.4.1 Game States

The game flow is managed by an `enum GameState`. The `display()` and `keyboard()` functions adapt their behavior based on the `currentGameState`.

3.4.2 Heads-Up Display (HUD)

Rendered using `drawText`, the HUD shows the current level, total accumulated score, and remaining cheese. It also displays ”CAT SLOWED!” when the power-up is active.

3.4.3 Difficulty Scaling

Cat speed (`currentCatDelay`) decreases (speeds up) as cheese is collected, following a non-linear curve.

3.5 Core OpenGL Concepts Used

- Windowing and Callbacks (GLUT)
- 2D Orthographic Projection (`gluOrtho2D`)
- Matrix Stack and Transformations (`glPushMatrix`, `glTranslate`, `glScale`)
- Drawing Primitives (`GL_QUADS`, `GL_TRIANGLES`, `GL_TRIANGLE_FAN`)
- Color Management (`glColor3f`)
- Double Buffering & Smooth Animation
- Blending for Transparency
- Anti-Aliasing
- Bitmap Text Rendering

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5 Additional Screenshots

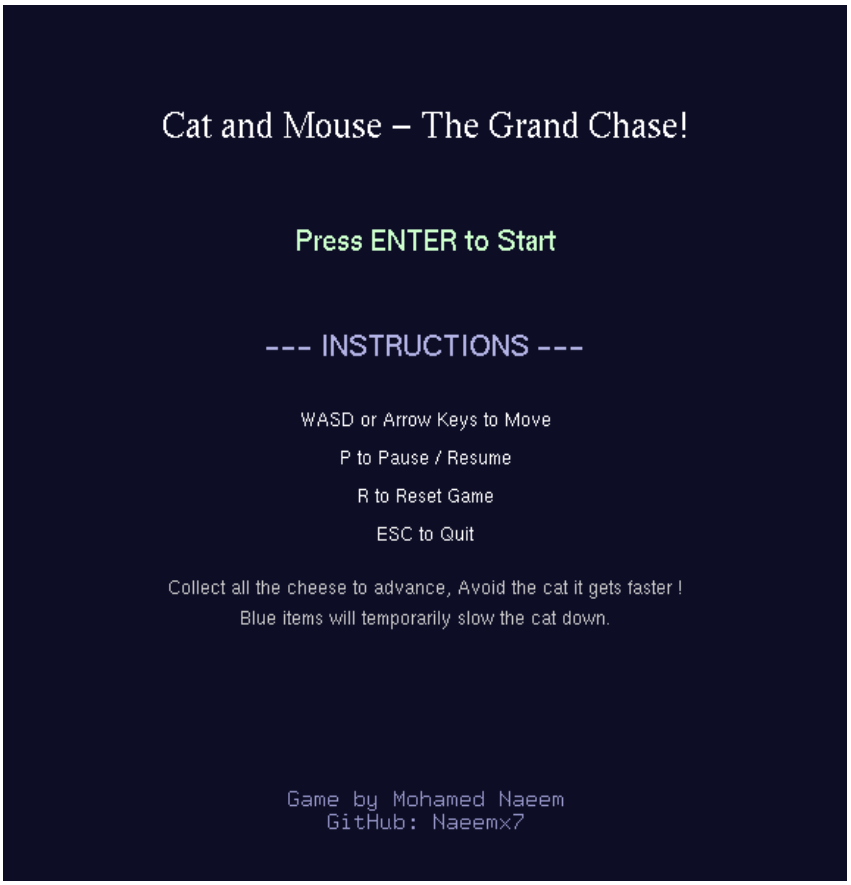

Figure 5: The initial Start Menu screen displaying the game title and control instructions.

Figure 6: Gameplay action on Level 1. The player (mouse) navigates the maze, collecting cheese (yellow triangle) while avoiding the AI-controlled cat.

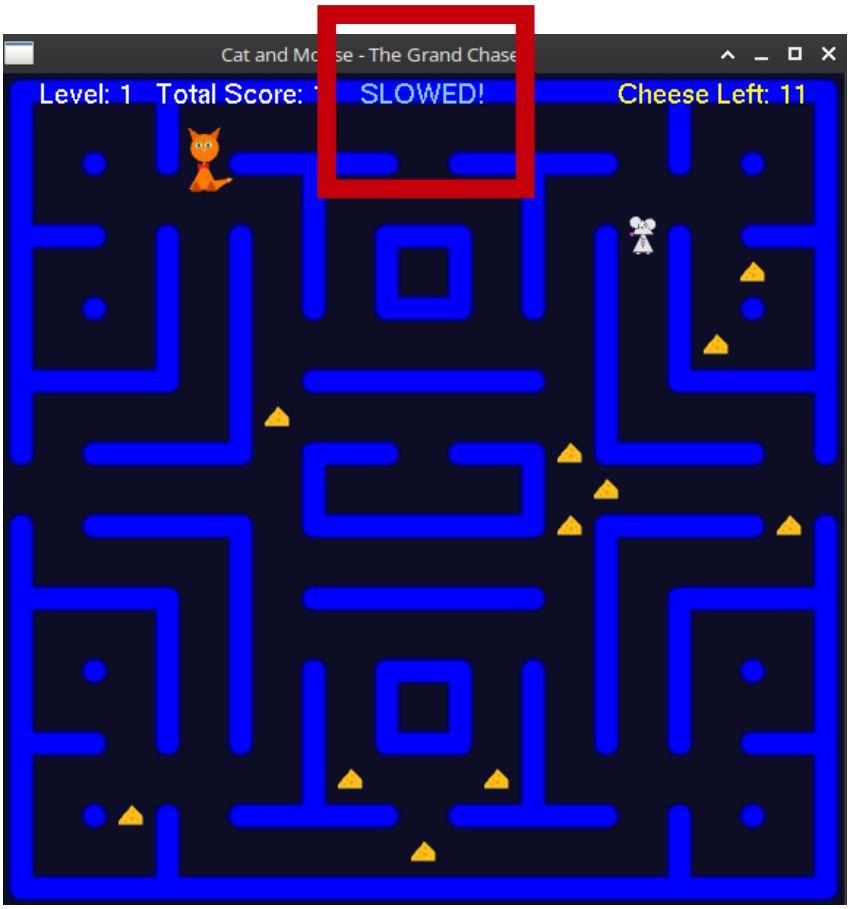

Figure 7: The Heads-Up Display (HUD) showing ”CAT SLOWED!” in the top center after the player collects a blue power-up item, indicating the cat’s movement is temporarily reduced.

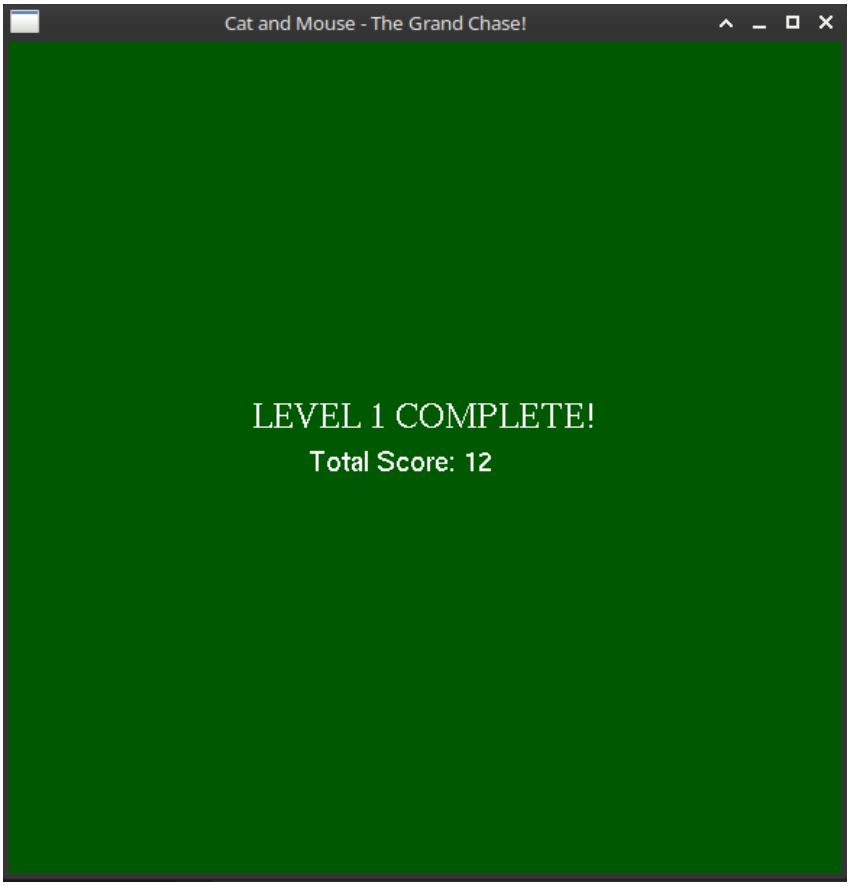

Figure 8: The ”Level Complete” screen, which appears after all cheese on a level has been collected, displaying the player’s total score.

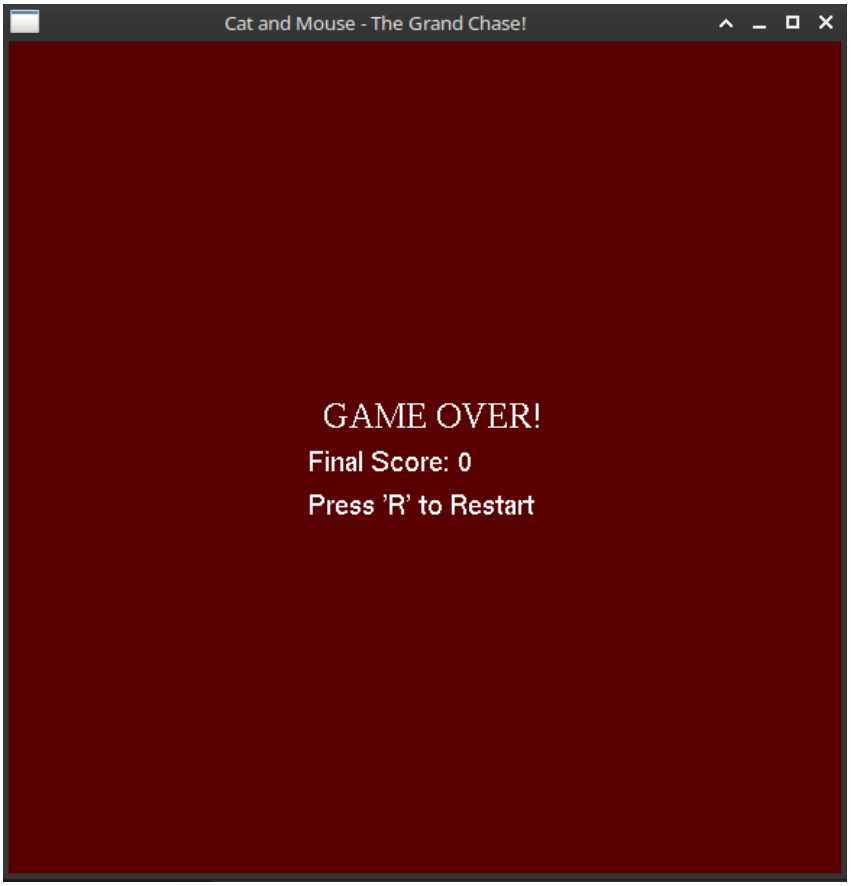

Figure 9: The ”Game Over” screen, shown when the cat catches the player, displaying the final score.