Group Project: A Simple Interactive 3D Game

Due: April 16

1 Overview

This project gives you an opportunity to apply everything that you have learned in the semester and be proud of your accomplishment. In order to show that, you will develop a simple 3D interactive game that features interactive computer graphics. You may choose to implement your game as a web application (using WebGL or Three.js library) or a mobile app (using OpenGL ES 2.0).

You may work in groups of 2 or three students. With a group of three students, the game shall include more game objects.

2 Requirements

Most of the requirements described below are similar to what you have seen in the previous projects, but the main theme of this project is *interactive manipulation with a purpose.* So, instead of simply controlling 3D objects to spin, tumble, move, etc., you will now do these animations in order to achieve a goal to win the game.

2.1 Game Design

- The player shall use one or more interaction mechanisms (keyboard, mouse, touch screen, sensors on a smartphone) to manipulate 3D objects in order to win/earn points the game.

- The program shall keep a score for each task the player performs in the game and update the UI to show the current and final score

- Include an element of randomness in the game, such as placing your game objects at random location, or moving them at random speed.

- Include one or more geometric queries in the game actions. For instance, you can earn points when your car is parked nearby a tree or animate a tumbling trash can when your bike hits it

2.2 Graphics Design

- Show animation of the game objects when the player moves them in the game

- The overall visual appearance of the game must be three-dimensional (3D objects projected onto a flat background are not acceptable)

- Render the graphics with lighting enable and make sure that normal vectors are calculated correctly

- Include 2D texture mapping to render both flat and curved surfaces

- Render the graphics using a carefully selected combination of colors to create an interesting visual appearance

3 Grading Components

3.1 Game Logic (6 pts)

- (3 pts) Score keeping and updates. Your game must include some element of **randomness** in order to earn game points

- (3 pts) Winning the game

3.2 3D Objects and Animations (19 pts)

- (6 pts) Quality of 3D design (aesthetic, realism, color choice, shapes, ...)

- (5 pts) Animations using combined transformations

- (4 pts) Lighting and shading

- (4 pts) Use textures

3.3   Interactive Control on Game Objects (10 pts)

- (5 pts) Demonstrate use of coordinate frames for each controllable object

- (5 pts) Control the game object with 6 degrees of freedom (rotation on 3 axes and translation on 3 axes)

3.4   Program Design (5 pts)

- (3 pts) Use appropriate data structures (array, maps, trees, hash tables) to store your game data

- (2 pts) Modular design

3.5   Additional Grading Items

Select some of the features from the following list to earn more points in the project

- (4 pts) Geometric queries for earning points or collision detection. You will earn 4 points for each **type of query** implemented in your program. Some practical examples of geometric queries:

  - use the hit angle between an arrow and a balloon to calculate points
  - firing a laser gun to hit a target requires determination of intersection between a line and a plane.
  - changing an object color as you approach it requires distance calculation between the player and the target object

  Note that all these examples of geometric queries can be based on vector operations.

- Use your own vertex shader + fragment shader programs (beyond the instructor's example). **Up to 10 points** per VS+FS pair.

- (8 pts) Control the game objects to follow a curve or surface

- (3 pts) Use device sensors (on smartphones) to control the game

- Other interesting visual effects implemented in the game

Proposal

Submit a single-page proposal to give your instructor a rough idea how the game will be implemented. Address the following questions in your proposal:

1. 3D Graphics

   - Sketch the main 3D objects involved in your game, hand sketches are acceptable
   - If you plan to use ready-made objects created by other developers/designers, include the source of your 3D models
   - Describe how the game objects will be animated during the game

2. Game Mechanics

   - Describe how each object is involved in the game mechanic and how the user will interact with the object
   - How do the player(s) win the game?

3. Implementation

   - Describe as much details as you can regarding the proposed implementation: programming language, libraries
   - List the extra credit options you are planning to pursue and implement