A flying Robot Guarding A Diamond in the Garden

COMP_SCI 351-1: Intro to Computer Graphics

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1. Goals and Project Description

1.1 Goals

The goals of project B contains 3 parts.

- First of all, create a 3D 'world' that users can explore with a movable 3D camera using GUI controls.
- Second of all, make 2 side-by-side viewports (2/3 height of the window), one for persperctive camera and another for orthographic camera (width and height match perspective camera's view frustum at -z = (far-near)/3).
- Third of all, show ground-plane where +z is 'up' and x,y appear horizontally on-screen, and draw 4 or more 3D assemblies on the top of the ground plane.

1.2 Project Description

Fig 1 shows the overall design of project B. This 3D world contains 6 assemblies: 2 trees, 1 robot, 1 diamond, 1 plateform and 1 gate. *The robot* is flying randomly on the screen guarding the diamond. *The diamond* can be rotated by mouse-drag using quaternion rotation correctly at all viewpoints. *The trees* and *the cloak* on the robot have 3 joints and 4 segments which is animated and can be adjusted.

Besides, there are 3 *axes* in total, one stands for the world coordinate (at the origin), one for the joined tree, and another for the diamond which can be rotated by mouse.

There are two viewports in toall, the left is for perspective camera and the right is for orthographic camera. With keyborad control, camera can aim in any direction without changing position and can also move backward, forward, up, down, and 'strafe' along sideways smoothly.

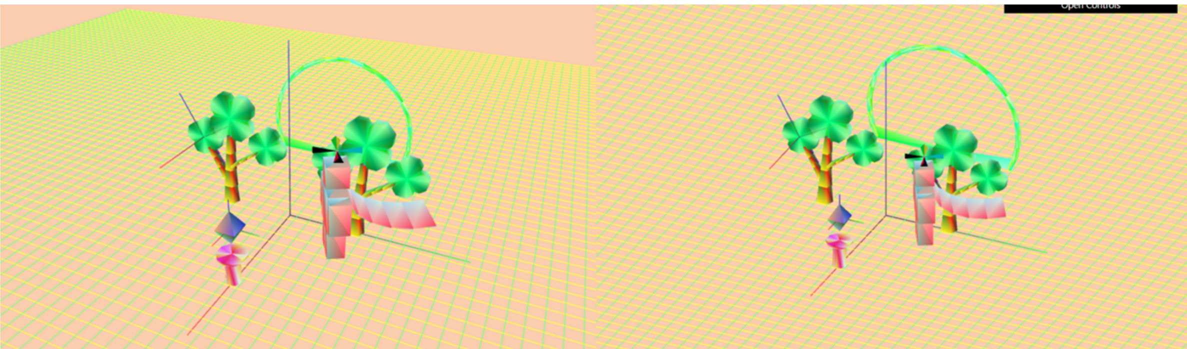


Fig 1 Overall View of Project B

2 User Guide

2.1 Keyboard control

1. Arrow keys aim the camera without moving it:
   - "←""→"arrow keys rotate view left/right
   - "↑""↓"arrow keys tilt up/down
2. "WASD" keys move the camera without rotating it:
   - A/D keys 'strafes' camera left/right at current altitude
   - W/S keys move forwards/backwords in direction-of-gaze
3. "QE" keys move the camera up/down along the z-axis of the world coordinate system

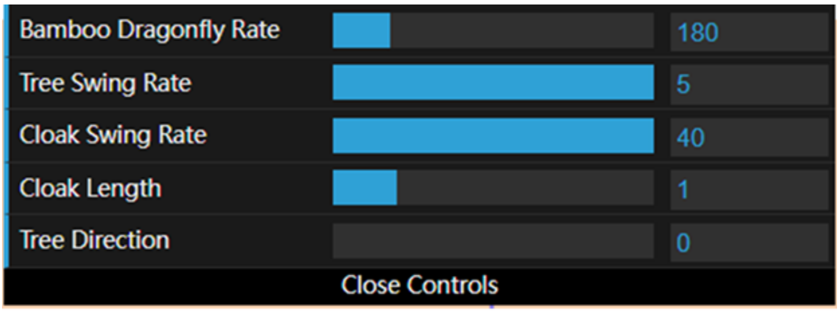
2.2 Mouse-Drag Control

The diamond (octahedron) can respond to mouse-draging by qaternion rotation at all viewpoints.

2.3 GUI Control

In GUI control menu, there are 5 parameters to be controled.

- Bamboo Dragonfly Rate for the speed of bamboo dragonfly
- Tree direction can change the orientation of the tree
- Tree swing rate for swing speed of tree
- cloak swing rate for swing speed of cloak
- Cloak length can control the length of cloak



Bamboo Dragonfly Rate	180
Tree Swing Rate	5
Cloak Swing Rate	40
Cloak Length	1
Tree Direction	0

Fig 2 Control Menu

3 Result

3.1 Initial Position of Camera

As shown in Fig 3, the camera initial position is at (3.2, 0, 0.5).

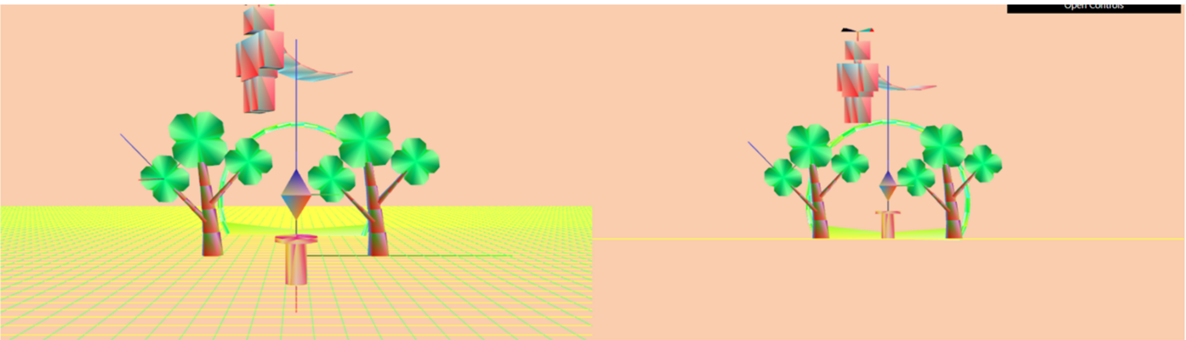


Fig 3 The initial position of the camera

There is a gate in the behind. The trunk of the tree and the cloak of robot are all animated, adjustable 3-jointed, 4-segment assembly. The diamond can be rotated by mouse. And there are 3 axes, one for world coordinates, two for movable assemblies (leaf and diamond).

3.2 Changing the Direction and Position of Camera

Use the keyboard control, we can change camera's position and direction to look at 3D world from a different view, as shown in Fig 4.

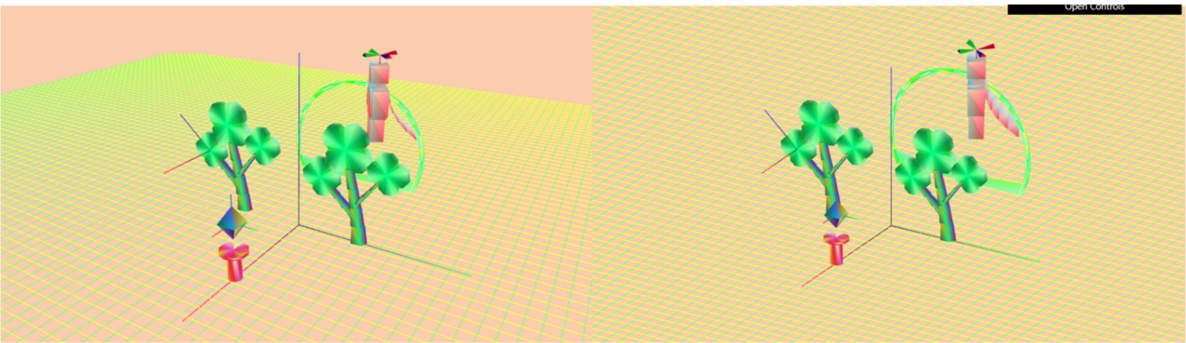
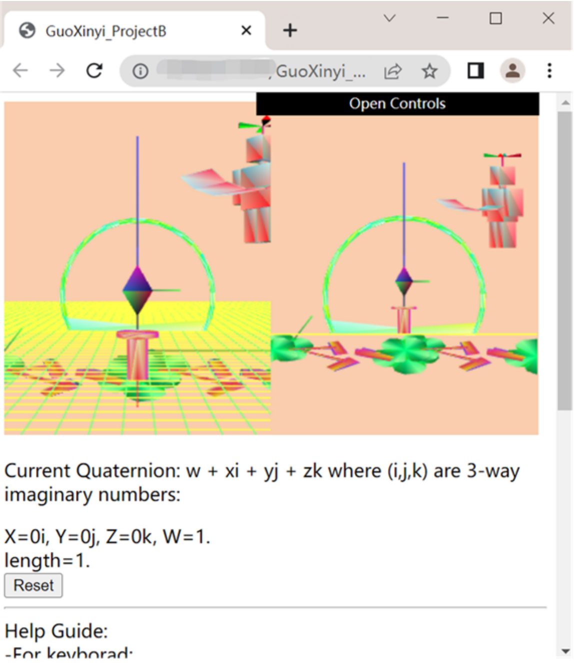


Fig 4 Camera After Changing the Direction and Position

3.3 Re-size the Window

As Fig 5 shows, the two viewports always fill browser window width and take up of 2/3rds of window height. when users re-size the window, the view of 3D world will never be squashed/stretched.



Current Quaternion: w + xi + yj + zk where (i,j,k) are 3-way imaginary numbers:

X=0i, Y=0j, Z=0k, W=1.
length=1.

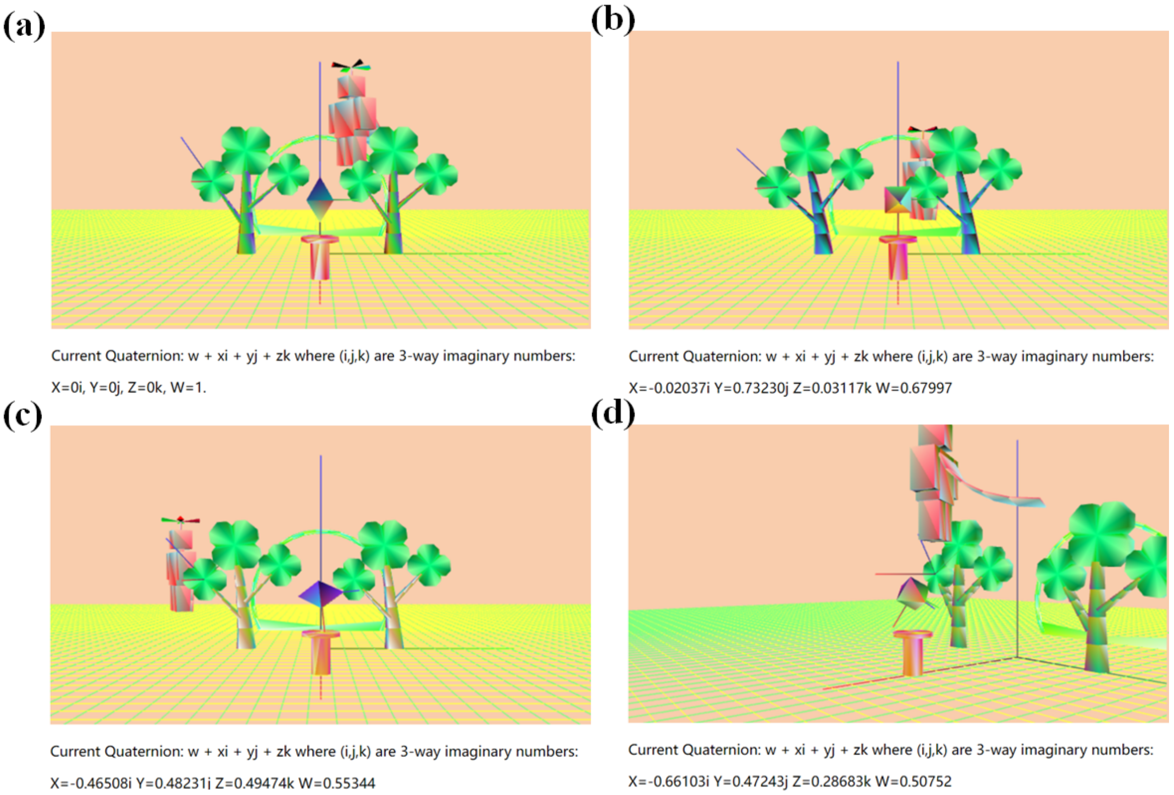
Reset

Help Guide:
-For keyborad:

Fig 5 Re-size the window

3.4 Mouse-Drag Rotations

Fig 6 shows the mouse-drag quaternion rotation for the diamond. The camera is at initial position for (a)(b)(c), it always appears to be perpendicular to mouse-drag directions. After changing camera position and direction in (d), the mouse-drag rotations also work correctly.



(a) Current Quaternion: w + xi + yj + zk where (i,j,k) are 3-way imaginary numbers:

X=0i, Y=0j, Z=0k, W=1.

(b) Current Quaternion: w + xi + yj + zk where (i,j,k) are 3-way imaginary numbers:

X=-0.02037i Y=0.73230j Z=0.03117k W=0.67997

(c) Current Quaternion: w + xi + yj + zk where (i,j,k) are 3-way imaginary numbers:

X=-0.46508i Y=0.48231j Z=0.49474k W=0.55344

(d) Current Quaternion: w + xi + yj + zk where (i,j,k) are 3-way imaginary numbers:

X=-0.66103i Y=0.47243j Z=0.28683k W=0.50752

Fig 6 Mouse-Drag Rotation (a) Diamond before rotation; (b) First rotation; (c) Second rotation; (d) Rotates at another viewpoint

4 Scene Graph

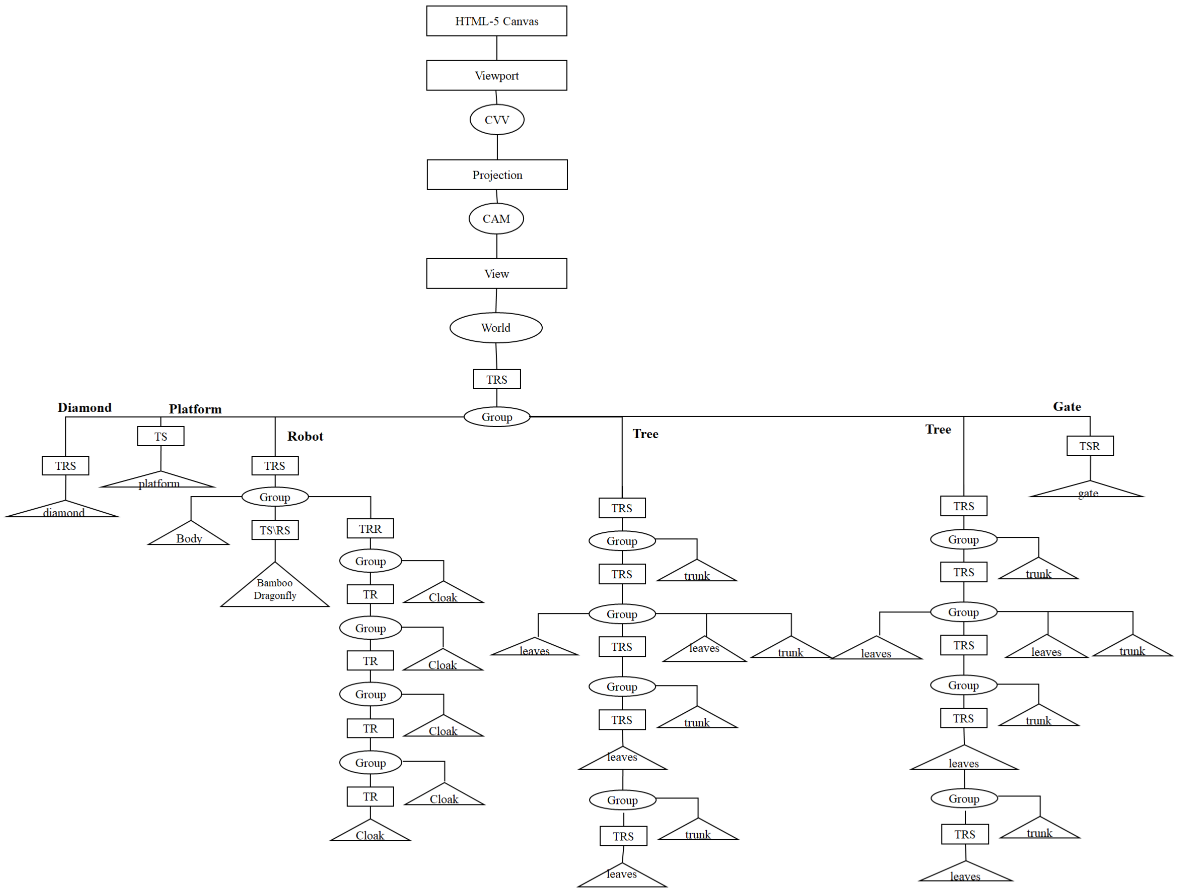


Fig 7 Scene Graph