Optical Illusions Art Gallery

Declaration

I declare that this assignment submission represents my own work (except for allowed material provided in the course), and that ideas or extracts from other sources are properly acknowledged in the report. I have not allowed anyone to copy my work with the intention of passing it off as their own work.

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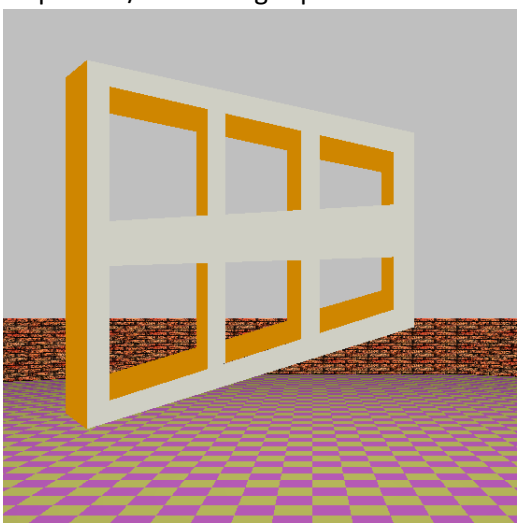
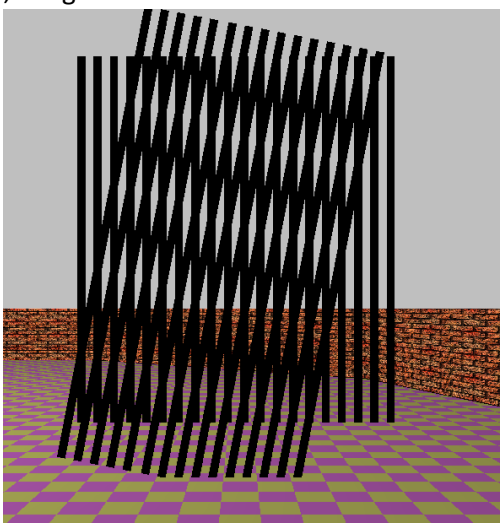
Description

The scene has 3 animated art objects (AAO), newtons cradle (AAO3), ames window (AAO1) and a rotating moire pattern (AAO2). The newtons cradle has physics simulation and displays 2 independent animation sequence with 1 and 2 balls dropped which cycles between them when the energy in the system gets low enough. The newtons cradle also has planar shadow system for all the balls. The scene has 2 static illusions which can be seen in the gallery view. The entire scene is surrounded by a quad strip with a repeated brick texture applied.

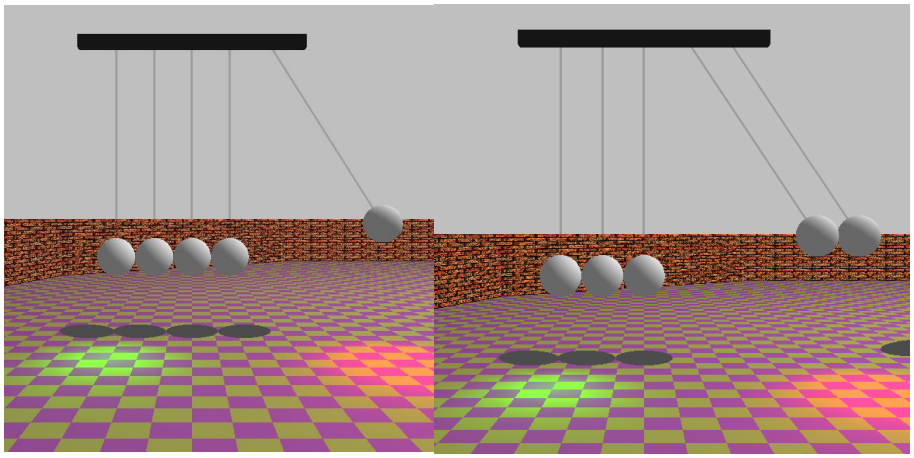
- Screenshots of AAOs and the gallery. You may also include screenshots or descriptions of any important/interesting aspect of the models, images and animations.



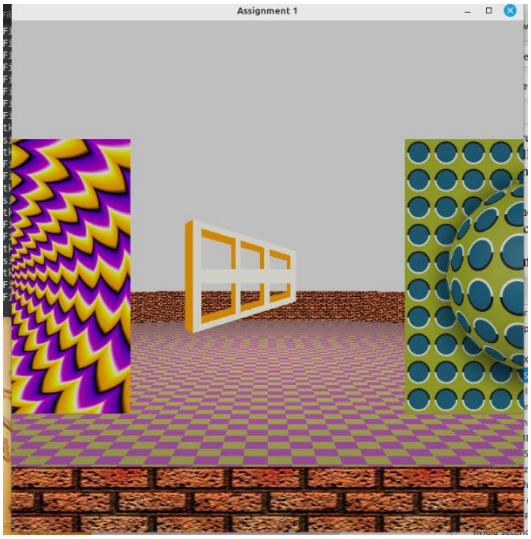
AAO 1: Ames window



AAO 2 Rotating Moire pattern



AAO 3 Showing both animations (1 and 2 balls dropped). The planar shadows are simulated for each ball and the light source is in the middle above of the cradle slightly and in the positive z direction slightly. The 2 spotlights are on the end balls and are pointing to the ground.



Gallery View 1 : Default view, can use the arrow keys to freely move around

Extra features

- Planar shadows from the newtons cradle.
- 2 spotlights attached to the left and right ball in the newtons cradle.
- Physics based newtons cradle animation.
- Texture mapped quad strip (brick wall).
- 2 texture mapped quads (2 different illusions).

Images of diagrams

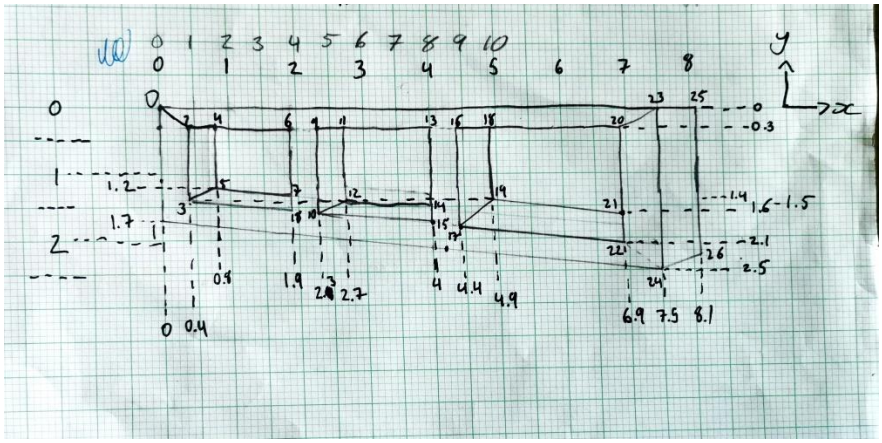


Figure 1 Diagram used to model the Ames window. Note dimensions have been changed.

Equations

- Newtons cradle:
  - Update position of ball:
    - $x = (balloffsetX + stringLength) * \sin(ballAngle)$
    - $y = (balloffsetY + stringLength) * -\cos(ballAngle)$
      - Balloffset is the initial starting position of the ball relative to the scene origin and ball angle is the angular displacement of the ball on the string in radians.
    - $\alpha = \tau / I$
      - Since the inertia of the ball is assumed to be 1 I is ignored
    - $\alpha = -(-stringLength * m * g * \cos((ballAngle - 45)) - stringLength * m * g * \sin(ballAngle - 45))$
      - Where m is the mass (1 for all balls and equations) g is -9.81.
    - $\omega_f = \omega_i + \alpha * dt$
      - Where dt is change in time (set to 0.02)
    - $ballAngle \mathrel{+}= \omega * dt + \frac{1}{2} \cdot \alpha \cdot dt^2$
  - $Collisions$:
    - $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
    - Distance between 2 points to check for a collision between the ball. To prevent clipping if the 2 balls are within 2 times the radius the and of the balls are moved away from each other until they are no longer clipping.
    - If a ball does collide the angular momentum of the balls are switched.

Controls

Key	Action
1	AAO-1 View
2	AAO-2 View
3	AAO-3 View
0	Gallery View
←	Camera: Turn left
→	Camera: Turn right
↑	Camera: Move forward

↓	Camera: Move backward
Page up	Camera: Raise height
Page down	Camera: Lower height
4	Reloads the off files

Build Commands

In order to get the full animation speed please disable v-sync in the nvidia control panel under the opengl settings. A diagram showing how to do this is shown below in figure 2

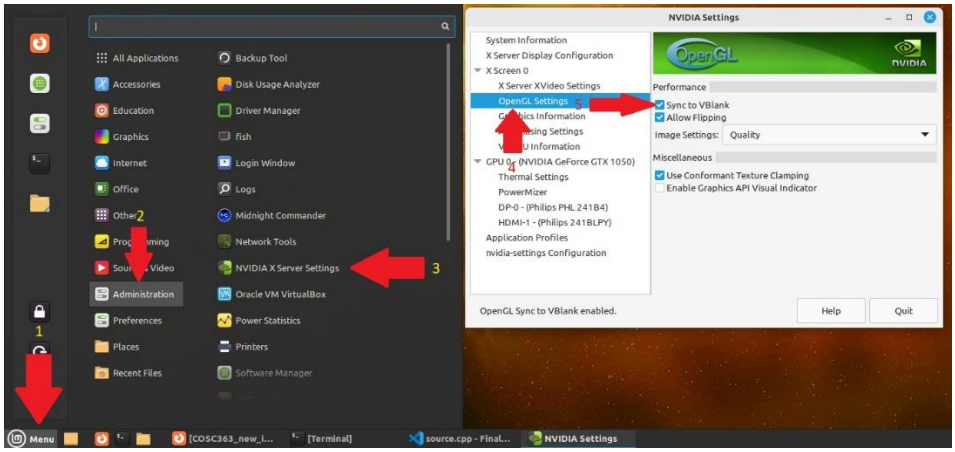


Figure 2 How to disable v-sync on the lab machines

To build and run the program use the following commands in the project directory:

g++ source.cpp objects.cpp physics.cpp -I/ -lGL -lGLU -lglut
./a.out

References

Equations for the AAO3: https://www.nzqa.govt.nz/assets/qualifications-and-standards/qualifications/ncea/NCEA-subject-resources/Physics/L3-res-13-phys.pdf

The textures used for the 2 static illusions: https://www.shutterstock.com/blog/illusion-of-movement-in-static-design