**Project 9: Advanced Shaders 1**

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CST-305: Computer Graphics

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**Video: (Also included in repository):** <https://codingcando.com/fileShare/file?code=OFGCAZJWAM>

**Project Description and Main Idea**

This project consists of creating a checkered board with different shapes resting on the checkered board. Then, the camera is adjustable using a set of keyboard controls. These keyboard controls allow for a user to navigate around the scene. The goal of this project is to visualize how shaders can be used to visualize objects on a flat “ground”.

The resulting image:

A screenshot of a video game

Description automatically generated

**Theoretical background**

In computer graphics, shaders are programs that are run on a GPU, which is a processing unit on a computer that specializes in parallel arithmetic operations. A shader instructs a GPU to compute the colors for the pixel values that it receives. In this program, shaders are used to convey the positioning and coloring of each object, including the checkered board. This project, project 9, seeks to use basic shader functionality to render shapes.

**Mathematical concepts**

We are using Vertex and Fragment shaders. Vertex shaders are responsible for transforming the 3D coordinates of objects from their local space to clip space, applying operations like translation and rotation. Fragment shaders determine the color for each pixel after vertex processing. We use a combination of both to manage lighting and fine tune the rendering.

We are using the following shaders:

* checkerboard.vs/.frag
* cube.vs/.frag
* cylinder.vs/.frag
* sphere.vs/.frag

For 3D Vertex Shaders, they take in three different matrices. The Model Matrix, the View Matrix, and the Projection Matrix. The Model Matrix converts the local space vectors to world space vectors. The View Matrix represents camera transformations. The Projection Matrix represents the camera space to flat screen space.

**Controls**

|  |  |
| --- | --- |
| Left Arrow Key | Move left respective to camera |
| Right Arrow Key | Move right respective to camera |
| Up Arrow Key | Move up respective to camera |
| Down Arrow Key | Move down respective to camera |
| Shift + Up Arrow Key | Move forward respective to camera |
| Shift + Down Arrow Key | Move backward respective to camera |
| Ctrl + Up Arrow Key | Tilt camera down, pitch down |
| Ctrl + Down Arrow Key | Tilt camera up, pitch up |
| Ctrl + Left Arrow Key | Rotate camera counterclockwise |
| Ctrl + Right Arrow Key | Rotate camera clockwise |

**Programming implementation**Top of Form

**Flowchart:**

A diagram of a program

Description automatically generated

**Desired Effect:**

A screenshot of a video game

Description automatically generated

**Screenshots**

A screenshot of a computer

Description automatically generated

Rotating the camera around for a secondary view.

A screenshot of a computer

Description automatically generated

Rotating the camera for a top-down view.