**Programming Project Report**

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**Problem Statement:**

The goal of this programming project is to extend an existing ray tracing program to learn more about ray tracing internals as we add several new features. We were required to add two of four features to the ray\_trace program in the CSCE4813 src directory. The four features we could add were display moving spheres, display different objects, cast multiple reflection rays, and add multiple light sources. I chose to display moving spheres and add multiple light sources.

**Design:**

For this programming project, I used Dr. Gauch’s ray\_trace program as well as ray\_trace3 for the timer function and movement for a reference. The biggest choice I made for this assignment was how I implemented the difference between one and multiple light sources. I chose to allow the user to switch between one and multiple light sources by pressing the m button. The program displays a sphere orbiting another sphere no matter which mode the user is in.

**Implementation:**

To start this assignment, I started by implementing the ray\_trace3 timer and movement code. After the spheres were moving, I set one sphere in the middle and just had one sphere moving. In order to get the sphere to move in a circle around the center sphere, I had to calculate the radius of the sphere:

   // Calculate radius after initializing sphere[0] and sphere[1]

   radius = sqrt(pow(sphere[1].center.px - sphere[0].center.px, 2) +

                 pow(sphere[1].center.py - sphere[0].center.py, 2) +

                 pow(sphere[1].center.pz - sphere[0].center.pz, 2));

This code sets the radius to be used in the timer function to calculate the position of the orbiting sphere. The equation for that is shown below:

   // Calculate new position

sphere[1].center.px = sphere[0].center.px + radius \* cos(angle);

   sphere[1].center.py = sphere[0].center.py + radius \* sin(angle);

**Testing:**

For testing, the only inputs that were allowed were m, +, -, p, n, and q. At the end of the assignment, everything was working as expected. The program outputs a sphere orbiting a center sphere and can switch between a single light source and multiple light sources.

**Conclusions:**

Overall, this project was a success. The program displays a 3D sphere orbiting a center 3D sphere, that are illuminated in two different ways. This project took about seven hours, with most of the time being spent on trying to implement different shapes that didn’t work.