**Programming Project Report**

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**Problem Statement:**

The goal of this programming assignment is to create a C++ program that reads 2 images of a penny, one is a regular picture and the other is a depth map image a use OpenGL to create a 3d wireframe of that penny, create a 3d model of that image using the wireframe and color data, and lastly implement the Phong Shading Model to give the model some realism. The normal inputs of this program are 2 penny images, one regular and one depth map, the user can also select the mode by choosing 1 (Wireframe), 2(3D Model), or 3(Phong Shading) and can rotate the penny in the negative x,y, or z direction by pressing x, y, or z and can rotate in the positive direction by pressing X, Y, or Z. The output should create a window where the user can see the 3 different pennies and can interact with them by using the keyboard. There was no error handling required.

**Design:**

I chose to read in the data and display the data all in the same CPP program which just makes running the program simpler but for a bigger project would be better to read in the data in one program and to display the versions of the penny in a different program. The data structure that I used were custom typedefs for an RGB type and all of the image data for the depth image and the RGB image. These custom types make writing and reading the code much simpler as you could tell what an object was by reading its type. The only algorithm that was used was the cross product and normalization of vectors used in calculating the normal vectors for the phong shading implementation.

**Implementation:**

I first read in the data from the 2 images and made sure that this data was being read and stored correctly into the custom data types that I created. Then I implemented the line strip or wire-frame penny, followed by the 3D RGB penny and lastly the phong shading model penny. I started with the sample code that Dr. Gauch provided for reading in the data from the penny images using the jpeg and lighting library. I extended this code by making it read the penny images and storing the data into my datatypes. Each step took me 1-3 hours and I did them one at a time as to avoid making big errors that would be hard to find.

**Testing:**

I tested the program by running it periodically and making sure that every small change that I made was correct and did not break anything, this helps to avoid spending hours debugging because of laziness. I also could visually inspect the output to test if the output was correct or not. The normal input of the program is 2 penny images and also some keyboard input from the user. There were not any special cases that needed to be tested. Everything worked as expected.

**Conclusions:**

The result of the project was a fully functional c++ program that reads 2 images of a penny, one is a regular picture and the other is a depth map image a use OpenGL to create a 3d wireframe of that penny, create a 3d model of that image using the wireframe and color data, and lastly implement the Phong Shading Model to give the model some realism. The overall result was a success. I would not do much differently besides maybe abstract out some of the complex calculations into a small Phong Shading library to make the code easier to read. This project took me approximately 4-5 hours to complete from start to finish.