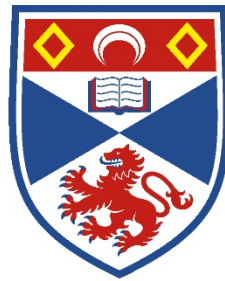**CS4102 Computer Graphics**

Assignment 2: 3D Rendering

Student ID: 170009479

Basic Requirement of 3D Rendering

Some important steps are explained in part 1 and the result is shown in part2. Flat shading is used in this assignment.

1. important steps explanation

 (1) Specify Light and Intensity
  add two labels, two drop downs, and one button to let the user to select options. Based on options, the parameters (x,y,z,intensity) of light are determined.

 (2) Data Scaling
  i. the absolute value of the x, y, z of each vertex are bigger than the width and length of the window, therefore data need to be scaled.
  ii. Data scaling is realised by using the formula:

$$x(new) = \frac{x(old) - minimumX}{maximumX - minimumX} \quad , \quad y(new) = \frac{y(old) - minimumY}{maximumY - minimumY} \quad ,$$

$$z(new) = \frac{z(old) - minimumZ}{maximumZ - minimumZ}$$

 (3) List triangles:
  i. Triangles is an array list of all triangles
  ii. Each triangle is created by determining the 3 vertexes of triangles
  iii. Each vertex is determining the value of x, y, z, and the color of the vertex
  iv. When a triangle is created, the color of the triangle is set automatically.

 (4) Set Color of each triangle:
  i. Calculate the unit normal of each triangle surface
   • the function 'calculateNormal' is in the class 'Triangle'.
   • To get the normal, cross product of vectors of two edges of the triangle is applied.
   • The coordinates of unit normal is calculated by using the formula:

$$x(unitnormal) = \frac{x(normal)}{length(normal)} \quad , \quad y(unitnormal) = \frac{y(normal)}{length(normal)} \quad ,$$

$$z(unitnormal) = \frac{z(normal)}{length(normal)}$$

  ii. Calculate dot product of the light vector and the normal
   • the function 'dotProduct' is in the class 'Triangle'.
   • Alpha is calculated by dot product which is between the unit light vector and the unit normal of the surface.
   • Alpha will be used in calculating the grey scale.

  iii. Calculate the grey scale of the triangle
   • When the grey scale is determined, the color of the current triangle is fixed.
   • The grey scale is calculated by using the formula:
    $x = alpha * 255 * intensity(light)$

 (5) Sort triangles:
  i. triangles should be sorted with the value of z-axis of the center point of the triangle.

ii. It is implement by the class 'TriangleComparator' and the function 'SortZ' in the class 'Model'.

iii. The target of doing it is to show triangles from back to forward, otherwise the forward triangles will be covered.

2. Results Demonstration

(1) When the light is not added, and the colors are decided based on the input data from 'face-texture.txt', the results are shown as figure1:

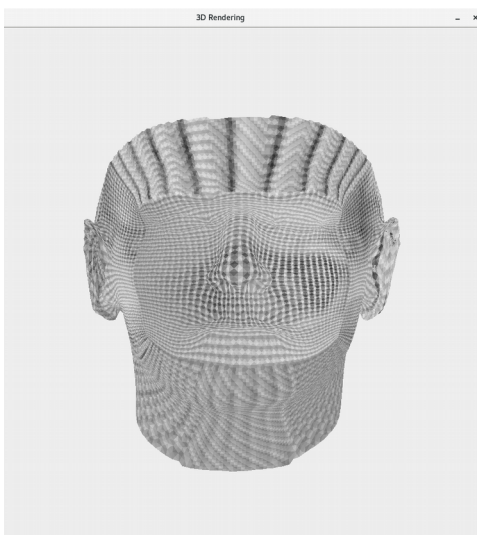(2) When the light is added, and the colors are decided based on calculation, the results are shown as figure 2:

figure 3

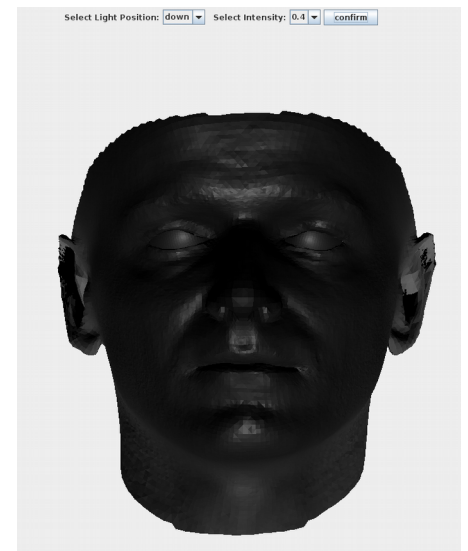*figure 2 Light position:right; Intensity:1.0*

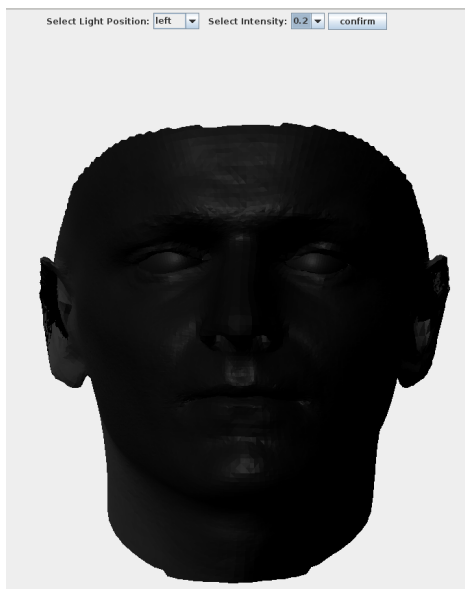*figure 1 Light position: down; Intensity:0.4*

figure 4 Light position:left; Intensity:0.2
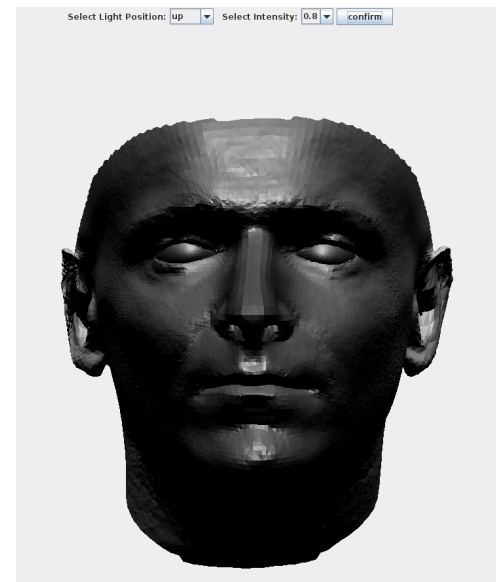

figure 6 Light position:front; Intensity:0.6

figure 5 Light position: up; Intensity:0.8