UTM
UNIVERSITI TEKNOLOGI MALAYSIA

SCHOOL OF COMPUTING
Faculty of Engineering

SESSION 2020/2021 SEMESTER 2

SECV 2213
FUNDAMENTAL OF COMPUTER GRAPHICS

PORTFOLIO

Name	**Nurul Syamira binti Amat Jifri**
I/C No.	**000613100080**
Matric No.	**A19EC0145**
Year/Course	**2SECV**
Section	**02**
Lecturer Name	**Dr. Goh Eg Su**

Table of Contents

ASSIGNMENT 1A

Introduction

For the very first assignment of the course, this assignment requires us to find a real-life sample of computer graphics application. Not only reasearching the application's functions, but also to define the computer graphics usage from any aspect. After completing, a short oral presentation needed to be presented to the lecturer of the students' findings.

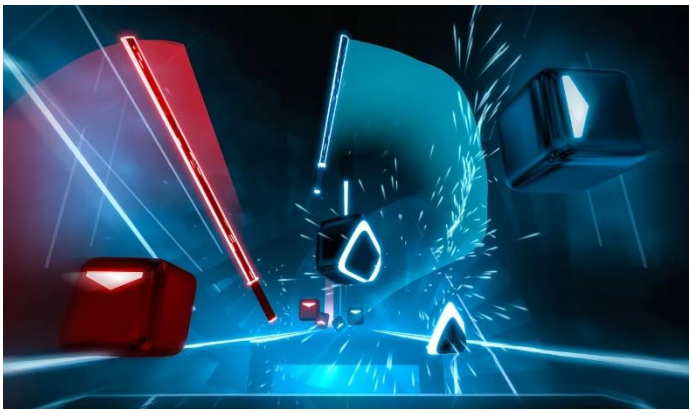
I teamed up with another two of my friends to complete this assignment. Each group needed to pick a topic from a list of topics provided. The topic Augmented Reality & Virtual Reality was picked from my group.

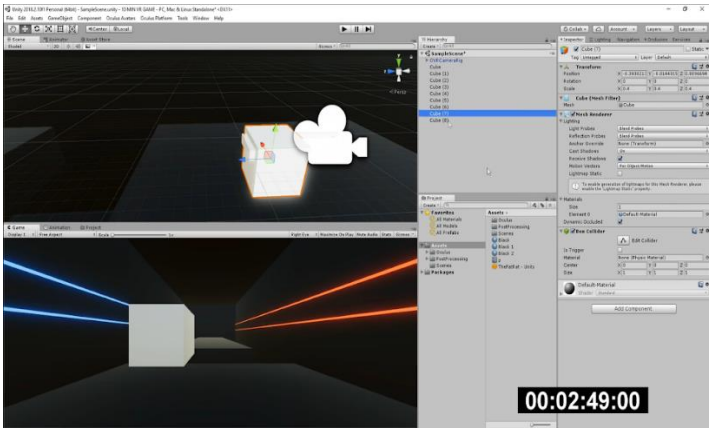
Describe solution/techinques used

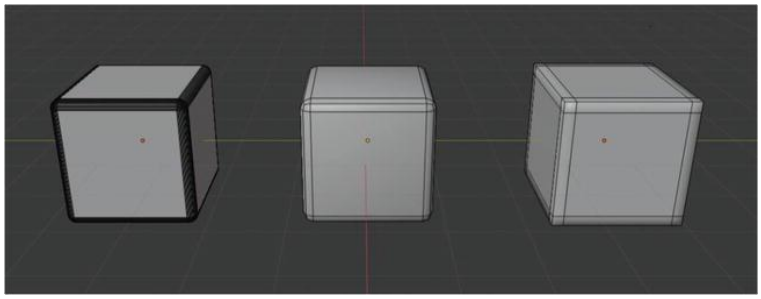
After we have decided on the sample application related to the chosen topic, tasks were assigned to each of us in the group. There were two applications that my group found to refer as the real-life sample for both augmented reality (AR) and virtual reality (VR). The applications referred for augmented reality is IKEA Place meanwhile for virtual reality is Beat Saber (VR Ryhthm Game). I was assigned to list the computer graphics term found and the conclusion in the report.

Results/Solutions

An user is using the IKEA Place application to visualize the furniture to be placed at the place.







Example of using bevel tools to create 3D models in the game application.

After researching and reading, I have discovered some of the computer graphics term found in both applications. The four main term I found are modeling, visualization, rendering and mesh. Both application focus on computer-generated simulation, which in AR, it added real-time directions and superimposing images. Hence, the use of visualization here is to interpret data graphically to deliver the characteristics of a 3D model.

Propose enhancement

In my opinion, both application my group referred as real-life sample is a good example. An enhancement I would like to propose is adding the list of computer graphic terms found from the real-life sample. Some of the terms that I found later while researching back are animation and rendering. The first one rendering is a process of generating a photorealisitic or non-photorealistic image from a 2D or 3D model by means of a computer program. Rendering includes some techniques in OpenGL such as shading, radiosity, raytracing and volumetric visualization.

Other than that, animation is a process of adjusting the positions and shapes various elements used in a model. Based on VR example, Beat Saber is a game application. Hence, the use of animation is crucial to create an environment of how all models in the application evolves over time.

Skills

After completing this assignment, I have gained more knowledge in the terms of computer graphics and how it works in a program. As the first step in this course, I am getting more excited and eager to learn more about computer graphics. Also, after doing a background search on both real-life application example, I realize that computer graphics play a crucial part in various industries such as education, entertainment, business and many more. This technology of computer graphics give positive impacts not only to the user but also the team of application developer.

ASSIGNMENT 1B

Introduction

This assignment is the partial assignment from the previous assignment, except that we are doing it individually and different task. Assignment 1B requires student to produce an OpenGL program that produces output in theme of Greeting Card or Festivity. Also, with each creativity, to compose different OpenGL primitives, colours and syntaxes into something relateable to the them.

From this assignment, I can explore more OpenGL functions, to compose the outputs into something meaningful in 2D or 3D model and to be able to explain my work.

Describe solution/techinques used

Based on the theme, I chose to do a Christmas greeting output. I am thinking to be able to draw a christmas tree using shapes. And, maybe add a gift box next to the tree. In the program, I use two functions which are drawLine(), drawShape() and as usual, the display() function. Not to forget, the main() function. In drawLine() function, I specify the coordinate of x and y from the vertex from coordinate position. In drawShape(), I use triangle shape as the Christmas tree. Hence, I write GL_TRIANGLES, as well as write the coordinates for the triangle vertex, glVertex3f(). In display(), I call the triangle drawn three times as the triangle will be placed on top of each other to form the image of Christmas tree. In addition, I draw a simple rectangle next to the tree using GL_QUADS and the coordinates for the vertex using glVertex3f().

Results/Solutions

This is how my output primitive looks like. I was devastated at first as the tree is displayed upside down. I have already checked the coordinates but I just am confused why it appears upside down on the output window. I think I'm still a bit weak in putting the coordinates in glVertex3f() function.

Propose enhancement

An enhancement that I would like to do is correcting the coordinates on glVertex3f() of the triangle so that the placement of each triangle will be precise and form a standing normal tree. And, I would like to add a stem to the tree using GL_QUADS. Also, on the top of the giftbox, maybe try to add few GL_QUADS shape that will form a ribbon.

Skills

From this assignment, I got a new knowlegde in using OpenGL. First of all, I learned how to enable OpenGL on Microsoft Visual Studio by following the steps on link that lecturer provided. Secondly, I learned how coding structure in this subject's looks like with the use of OpenGL. It is fine to learn on how to plot basic shapes for example, the triangle shape from plotting the coordinate system on the coding. Following the theme, I try to find a picture that I can generate using OpenGL.

ASSIGNMENT 2

Introduction

This assignment is assessed after Lab 2 which we learned about DDA Line Algorithm. From this assignment, I am pairing with my friend in the class as group members for next assignment and project. The instruction is to generate output primitives such as points, lines, circle and ellipse by extending the algorithms taught during lectures with the aid of OpenGL library.

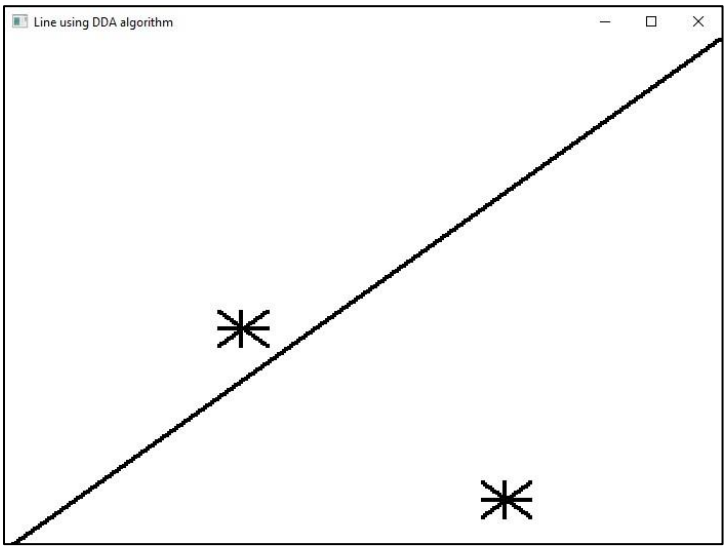
As I am in group of two person, so we need to complete a line using DDA line algorithm and a circle based on Midpoint Circle algorithm. I was assigned to the first one which is to generate the output primitive of a line.

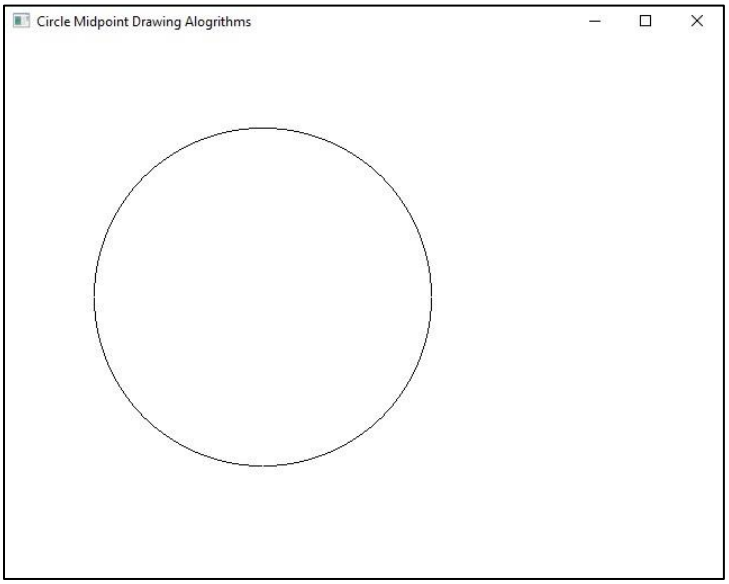
Describe solution/techinques used

We can use Lab 2 as guidelines to start this assignment as we first learned about DDA Line Algorithm during that lab exercise. To generate a pixel with suitable size, PlotPixel() function is ensured. For my part, I used the function in the name of setPixel(). I was in charge of writing a program to display a line. Hence, I decided to use the DDA line algorithm. In the program, only GL_POINTS is allowed to use to generate the output for this assignment. Starting with function Glint round() is for . The function init() is for rendering. To use the DDA line algorithm, I use lineDDA() function to implement the algorithm. They display() function is to call the lineDDA() and I draw three kinds of line which are an incline line across the output windown, and two lines that form stars. To form the stars, I aligned the coordinates precisely on each lineDDA() parameter which is the angles.

Meanwhile, my group member is in charge of doing the circle based on Midpoint Circle algorithm.

Results/Solutions





Here is our group's output for Assignment 2. The above one is a line using DDA line algorithm and the below one is a circle using Midpoint Circle algorithm. The output showed as what I intended to be, an incline line and two stars that are formed from DDA line.

Propose enhancement

For an enhancement from what I have done in my part, I can draw various kinds of line than just an incline line. With still using DDA line algorithm, I may have drawn any line with ending of two points using the algorithm.

Skills

For this assignment, I chose to do the DDA line algorithm than Bresenham as both algorithm is a line drawing algorithm. I noticed the importance of PlotPixel function, or as in my coding I use PlotPixel. The function PlotPixel will be called from display() function to plot a pixel. I am able to form a simple model which is star using only DDA line algorithm by choosing the parameter precisely.

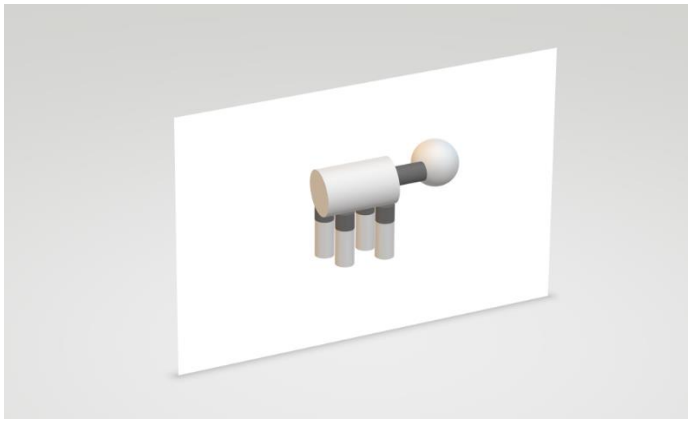
ASSIGNMENT 3

Introduction

The aim of this assignment is to implement 3D object modeling, hierarchical modeling and suitable 3D transformation of an object created. The design and coding are a creative representaion of a 3D character of animals except snake of our choice that moves hierarchically. This sheep is a combination of suitable 3D primitives or objects. Also, the model consists of 2 leels of hierarchy which is the root on the first level and the child nodes.

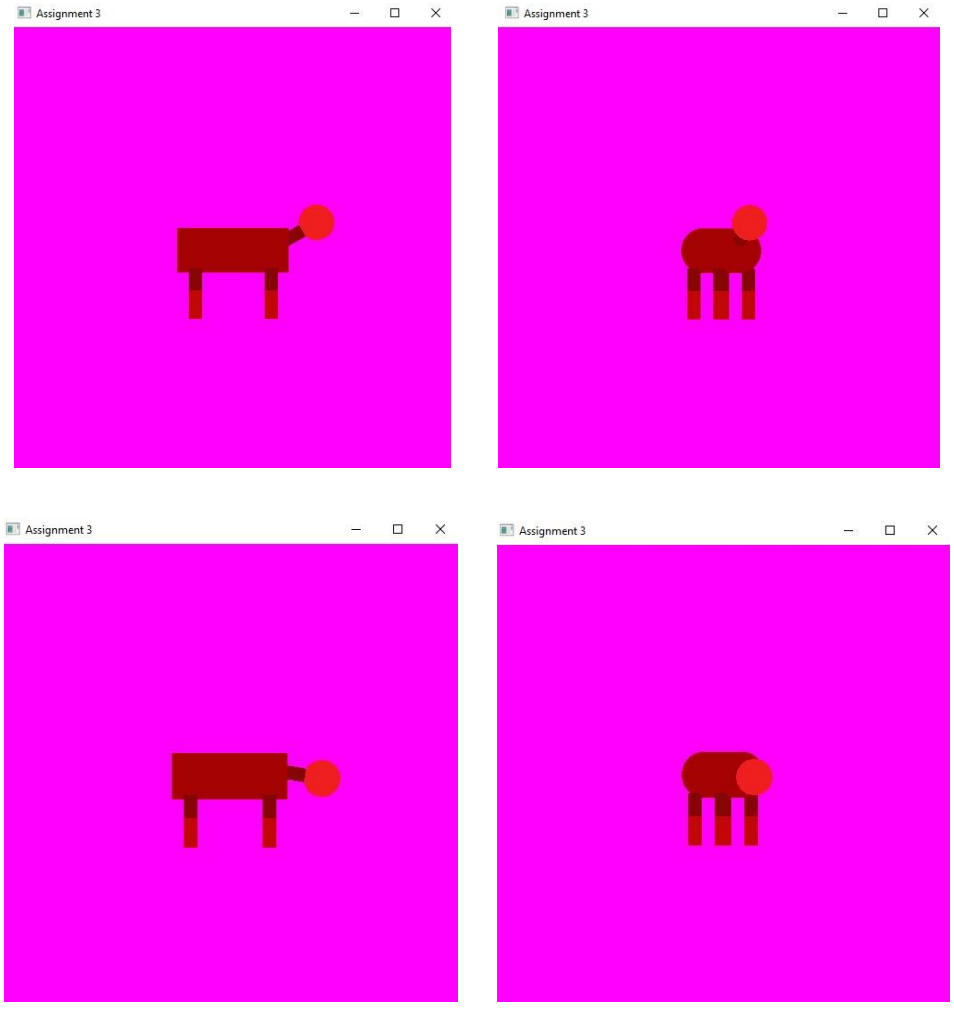
Describe solution/techinques used

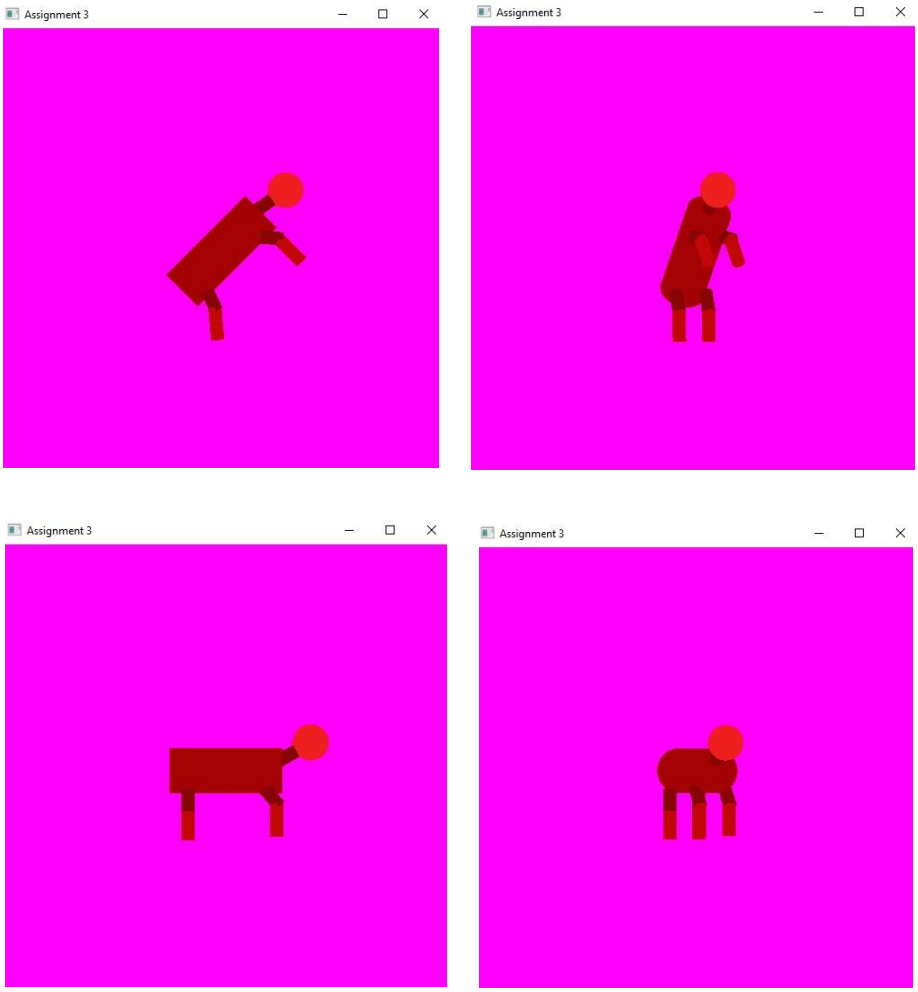
After a brief discussion with my group member, we decided to do a sheep using two shapes which are sphere and cylinder. In the program, the start will be initializing the angles are applied on z-axis only and are in order on each part of the model. Next, set the repeating movement for walk and run movement of the sheep later. The function draw_cylinder() is implemented to draw a solid cylinder with the given radius and height. The function init() is used as rendering in the program. The important function which is display() will lead how the output looks like. Each parts of the sheep model is drawn includes the torso, neck, head and four upper and down legs. Each part will be differentiate with glPushMatrix() and glPopMatrix() that helps to control the transformations applied, so that it will not affect other objects. The draft of the hierarchical modelling is as below:



The function updateAngles() is a method for rotation around x-axis and y-axis. Next, KeyboardKey() function is used to change the view angle of the model from side view to front view when the user clicks on the spacebar on keyboard. We also use an interactivity menu in our program using updateMode() and menu() function. When user right-click their mouse, there are few options of movement that the model can perform including the initial position, head down, legs up, walking, running and both legs up.

Results/Solutions





Propose enhancement

My propose of enhancement is to draw better hierarchcial model of an animal. Based on the animal we have done, it does not really show how a sheep looks like. It looks just like a 2D model of the animal. I want to add a little more detailed on the model like the face of the sheep.

Skills

From this assignment, I have learned about the importance of function glPushMatrix() and glPopMatrix() that helps in controlling the transformations applied, so that it will not affect other objects. I also learned about to do a movement on a model for a certain time in seconds. Also, I learned to do an interactivity menu that helps user to choose their own options on the model.

PROJECT

Introduction

The final project is an enhancement from Assignment 3. This project aims to implement 3D object modeling, hierarchcial modeling, proper camera, lighting and shading model using C/C++, OpenGL and GLUT based on the theme shich is animal moving character.

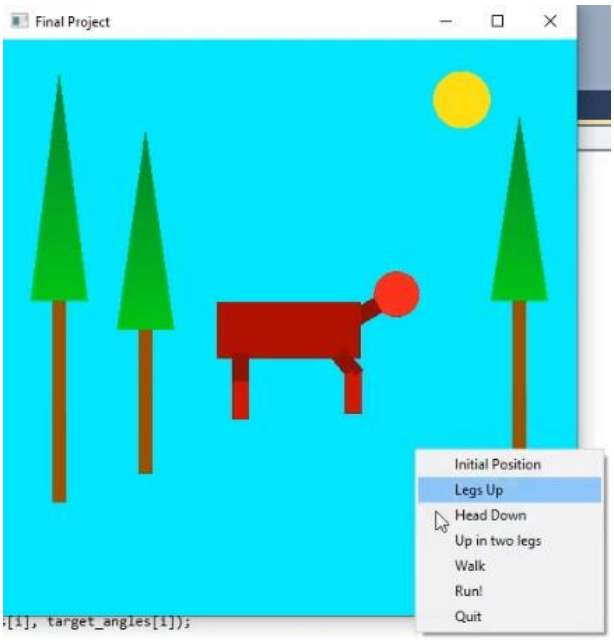
We continued the Assignment 3's model that we draw which is a sheep. To follow the requirements, we enable the model to rotate to some view angles and on x-axis. Also, we add some surrounding objects like a sun and trees. We also add a sound effect that is a sheep sound. Next, we use an interactivity menu for the model's movement. Last but not least, a ligthing and shading is also applied on the model.

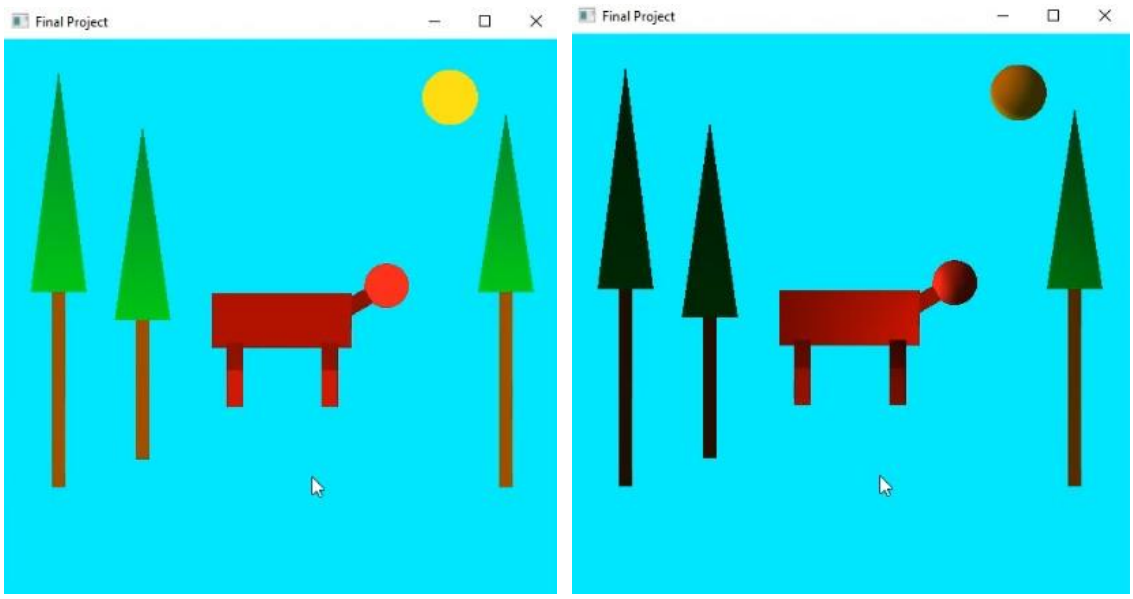
Describe solution/techinques used

The techniques used are basically the same with Assignment 3 whit some additional of functions. Firstly, the function PlaySound() is added to play a sheep sound when user press 'a' button keyboard. While 's' button to stop the sound from playing. For lighting and shading, we use some functions which are GL_DEPTH_TEST, GL_COLOR_MATERIAL, GL_LIGHTING, GL_LIGHT0, GL_LIGHT1 and GL_NORMALIZE. These functions will add ambient light, positioned light and directed light effects on our model. For keyboard function, user press 'd' button to glEnable() the lighting while 'f' button to glDisable() the lighting.

We also add few surrounding objects which are the sun and few trees. For the sun, we draw using glutSolidSphere and for the tree's leaves using GL_TRIANGLES. For the trunk of the tree, GL_QUADS is used. We also enable the model to rotate from each front, back, left and top angle. For this features, we use each is_front, is_back, is_left and is_top on KeyboardKey function. The function will be enabled when user press 'f', 'b', 'l' and 't' respectively. Other than that, we also make the model can be rotated on x-axis when user is moving their mouse. This will be implemented in mouseMove() and mouseButton() function.

Results/Solutions





Here are some of the outputs for different functions applied from our final project. The sound cannot be heard here, but when we are running the code, the sound is played. As long as the sound in .wav format is placed at the right directory and also in the coding.

Propose enhancement

My group member and I was a little confused about the hierarchical modeling. This is because we should have done a better animal model with more detailed and more described to look like a 3D model. From what we have done, it is a basic model that form an animal but do not really represent a sheep as what we intended to do. A better 3D modeling could be done to output a better animal model. Other than that, for the projection, a camera view of 360 degrees could also be implemented on the modeling. It may display a better view of the whole model.

Skills

There are few new things I have learned and implement for this final project. Firstly, I have learned to add any sound effect in the OpenGL program and it is important to have the audio in .wav format. Next, I learned about a complex function which is project and camera view. I also have mastered to do the lighting and shading on the model. This can be applied to differentiate day and night for the surrounding.

SUMMARY

Topics / Course works	Introduction	Graphics System Overview	Output Primitives	Enhancement/ Skills	Coverage
Assignment 1A	√		√	√	-Introduction to OpenGL -Understands the computer graphics technology
Assignment 1B	√		√	√	-Drawing simple shape -Produce an output following the theme
Assignment 2	√		√		-Implement line function to form a shape: DDA Line algorithm and Circle Midpoint algorithm
Assignment 3	√		√	√	-Create a hierarchcial 3D model -Enable movement for the model

Project	√		√	√	-Add more functions to the 3D hierarchical model -Understands the projection and camera model -Implements most of the functions learned

REFLECTION

As a reflection, I found this course is challenging yet useful to learn. After learning coding of C++ programming language since the first semester, it is quite exciting to learn a new application which is OpenGL while still using C++. It was my first time learning about OpenGL. I found it is beneficial to learn about OpenGL as the computer graphics program can be used in various industry such as business, entertainment, education and many more. Hence, learning OpenGL is an additional skill to myself for future career in the related industry.

Learning OpenGL was not easy at all, it needs a lot of understanding on the concept, the implementation of each function and the coordinates placement. Referring to all the materials, execised and lab exercise Dr. have prepared, it helps in better understanding of all the topics. However, I have a bit unsatisfied with my implementation for few tasks which are in Assignment 1B and the final project. It feels like I need deep learning to ensure I can get the output perfectly.

Overall, I am thankful for my lecturer, Dr. Goh Eg Su for teaching and guiding us through this semester for this course. It was a great learning and experience for me to learn about OpenGL and be able to generate output from doing the coding.