CG Project Report — Celestial Sphere

Jingyu LUO (16521724)

1. The program

In the folder “source”, there are three folders, code, framework and textures. The framework contains the source code of G53GRA framework, the code folder contains the source code of my scene, and the textures folder contains all the textures in .bmp format. To run the program, you need to compile all the source code files, since the program relies on the framework.

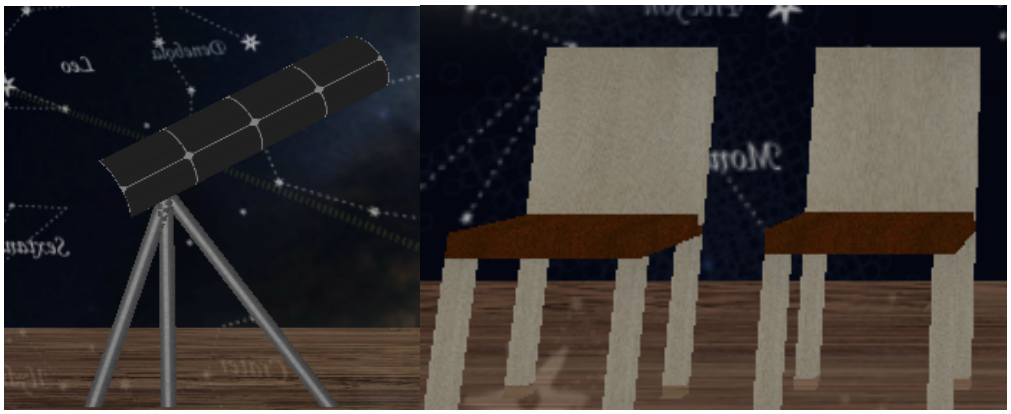
The directory of the textures is specified in MyScene.cpp and TexturedCube.cpp, it is relative directory, if failing to obtain the textures, it may require changing the directory to absolute directory or fix the relative directory.

2. Requirements of the project

2.1. Several 3D models

There are some objects in the scene, the two chairs and the telescope, I did not import any online models but I use hierarchical modelling to draw the models, for example the Chair object, the original starting position is set at the seat of the chair at its local coordinate, then use glPushMatrix and glPopMatrix to draw its legs and back sequentially, each component of the chair is encapsulated as functions, such as DrawSeat and DrawBack, and since all components are cubes with different shapes, the TexturedCube is used to draw the cubes with texture bound.

The telescope is composed by two parts, the cylinder as the lens cone and the base as the stand, I also use the hierarchical modelling to draw the telescope and rotate the angles of the components.



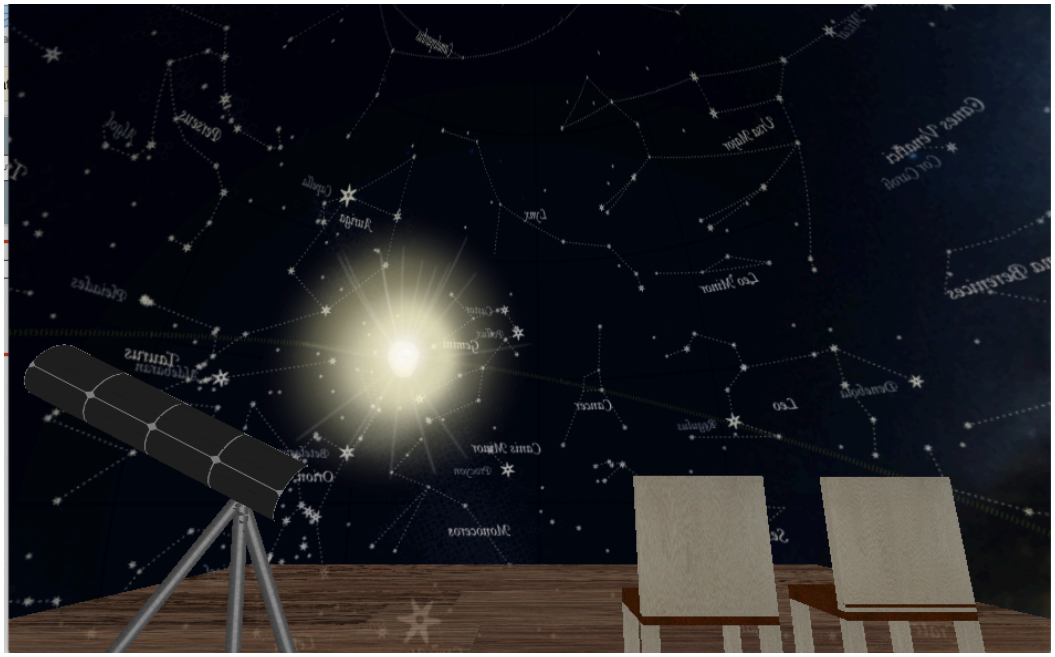
Other objects such as the sphere and the floor are added to the scene as background.

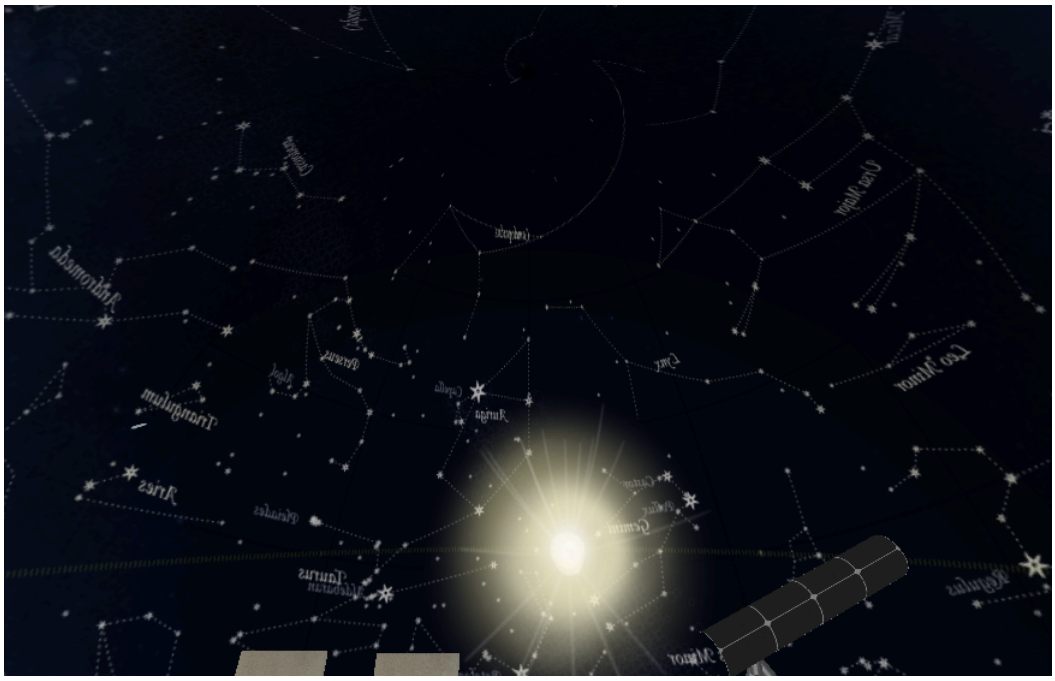
2.2. Transformation of models (scaling, translating, rotating)

The telescope can be moved by using keyboard, it can move along four directions on the floor, by pressing i, k, l and j. Also, the large celestial sphere keeps rotating in the background.

2.3. Different viewpoint to the scene environment

The position of the camera is controlled by using keyboard a, s, w and d, also, to change the viewing angle, drag the scene using the mouse, so different viewports can be seen. The following pictures demonstrates viewport from behind the chairs and look up the sky.



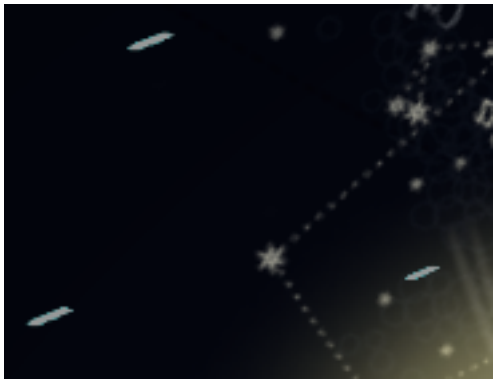


2.4. Animations for some objects in the scene

Apart from the moving telescope and the rotating celestial sphere, there all meteors in the background, I put four meteor objects in the scene, each of them continually crosses the sky.
The directions of them are all from top right to bottom left, each time, a meteor appears at a random position within a coordinate range, and once it meets the left end of its path, it is reset to the right side of the background to cross the sky again.

From the picture below, you can see the relative position of the meteors are different each time, so their trajectories and positions are random and not repetitive.

Also, each frame the length of the meteor is different, this adds a dynamic effect to the meteors.




2.5. Texturing

All the objects in the scene are textured, the two spheres are respectively textured with star map and milky way, by using GL_BLEND, the two spheres with different textures are blended and therefore you can see the milky way through the star map. As shown below, at the same position (constellation Leo Minor), the effects are different with and without the milky way as background.

Apart from the background, the objects are also drawn with textures, the floor is textured with wood. The telescope, its different parts are made of different metal materials and so does the chair.

2.6. Lighting – light effect in the scene

The light effect is also animated in the scene, it changes position as the sun changes its position, the position of the light source is always at the same side as the sun, since they have the same period of motion. So, the light effect gives a sense of sunrise and sunset, the background becomes brighter as the sun appears in the viewport, the background becomes darker as the sun disappear, and for different viewports, the effect is the same as their position are synchronized. From the picture below you can see the different brightness.

3. Creative ideas

The celestial sphere is a practical application, it can be used for amateurs to know some astronomy knowledges, such as the distribution and relative position of constellations. In this 3d scene I built, because of the huge number of constellations, I directly used the ready-made star map [1], but this still played the same role, which is to help understand the constellations.

I was inspired by some matured astronomical observation applications with the same features, you can rotate the celestial sphere and moreover, you can click a

single star to see its detailed information, but apparently, this workload is too much for this project, so I focused more on the scene and the animation.

In this scene, you can observe the stars in a stereo perspective, and you can change viewport as you want, which make it closer to a real astronomical observation application. The most interesting part I think is the lighting, because it simulates the sunrise and sunset, maybe in the future, I can add more celestial bodies such as the moon to the scene and simulates their movement and light effect. Also, by calculating the motion periods, I can simulate some astronomical phenomenon such as eclipse. To conclude, I think the idea is creative since it is flexible, meaningful, diverse and interactive.

Reference:

[1] Adams, M., Vigor Star Map. Retrieved December 10, 2019, from: https://storytellersnightsky.com/virgo-star-map