Solar System Simulation

Programming Assignment 7

CS 480 Computer Graphics

Team: Specular Bois
Members: Hadi Rumjahn, David Valenzuela, Jay Woo

Date Demonstrated
October 19, 2018

Table of Contents

Project Description

For this project we implemented a solar system simulation program. The program runs and shows the eight planets within our solar system plus pluto. Every planets' size is accurate with respect to each other. Orbital paths, orbital speeds, and rotational speeds are also accurate for each planet with respect to each other. Planets that have a moon in reality have a moon orbit around them in the solar system simulation program. Planets with more than one moon have only two moons which orbit around them.The user can change their view by moving the camera. The speed of the simulation can also be increased or decreased. Figure 1 displays how the program looks when running.

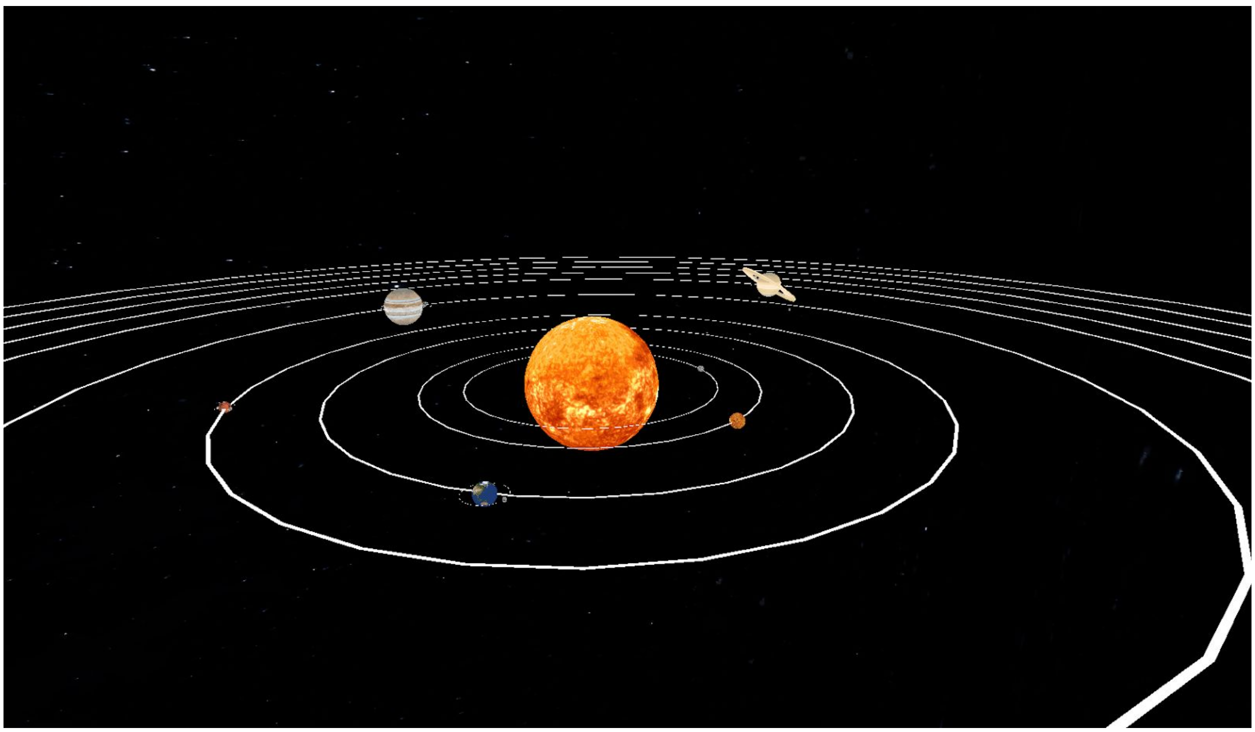

Figure 1. This picture shows what the PA7 solar system simulation program looks like when running. The earth and the sun can be seen in the above picture.

Overview

Dependencies

To run the program the following must be installed: GLEW, GLM, SDL2, OpenGL version 3.3, Assimp, and ImageMagick. The program also makes use of imgui but the files are included within the PA7 project github repository.

Extra credit

Live adjustment of simulation speed

While the program is running, a window will pop up which contains buttons. Clicking on certain buttons will change the speed of the simulation. There are varying speeds to adjust both the orbital and rotational speeds of the planets and moons. Each button is labeled with how much the simulation speed will change. Clicking the same button multiple times will not continue to change the simulation speed. For example, clicking the button to make the simulation speed twice as fast will not make the simulation speed eight times faster, if clicked on three times. The windows and buttons were created using the imgui library. In figure 2 we can see the various options to increase or decrease the speed of the solar system simulation.

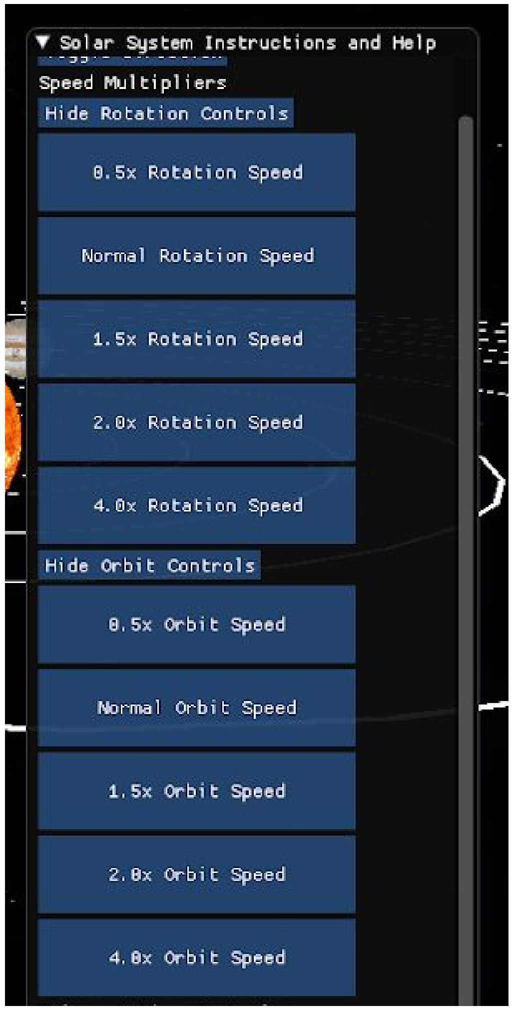

Figure 2. Shows various buttons which the user can click to increase or decrease the speed of the solar system. The rotational speed and the orbital speed can be adjusted.

Draws planet orbit path

There is a ring for each planet and moon showing their respective orbital path. These rings were created in blender and are objects. As an additional note there is no ring for the sun since the sun has no orbital path. Figure 3 shows the orbit paths of the various planets.

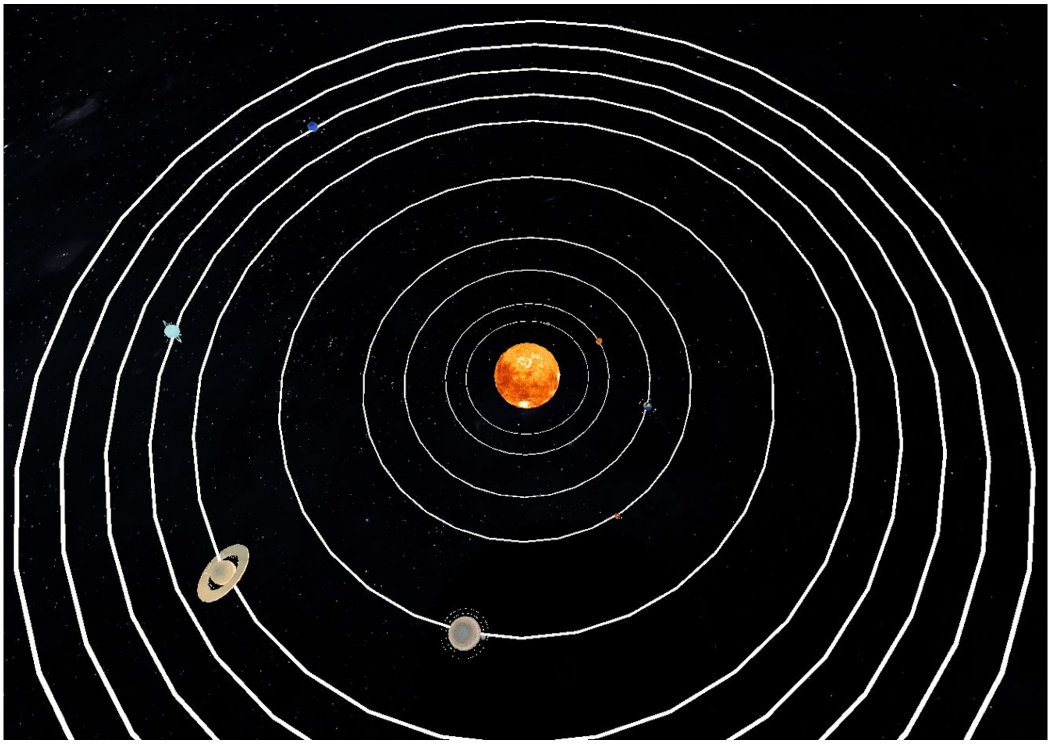

Figure 3. The above picture has white rings which show the orbit path for each planet. Saturn can be seen in the bottom left on top of the white line designating its orbit path.

Proper rings on other planets

The planets Saturn and Neptune have their own ring which constantly orbits around them. The ring is independent of the planet and has its own rotational speed which can be changed without affecting the planet. Figure 4 shows both planets with their respective rings.

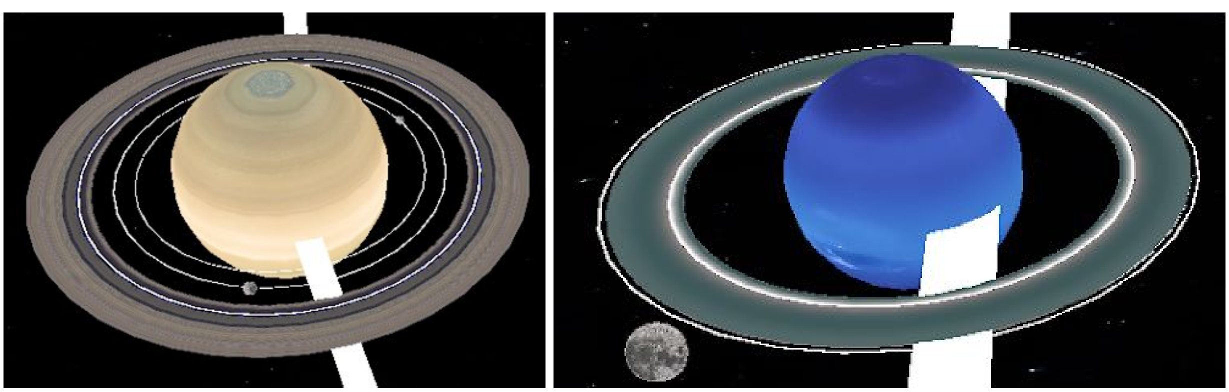

Figure 4. On the left is a picture of the planet Saturn with its ring. Next to it is a picture of Neptune with its own ring.

Considerations for extra credit

Stars can be seen in the background

To make our solar system feel more realistic we added a background where it looks like stars appear far off in the distance. This was done by texturing a large sphere with stars and placing the solar system inside the sphere. The background constantly follows the camera so that the camera can never get closer to the background. This was done to create the feeling that the stars are infinitely far away.

Figure 3. This figure shows a picture of the background setting for our solar system simulation. The white spots scattered throughout the picture represent the stars scattered throughout the universe.

Sound added to solar system simulation

Music will play while the program is loading in all of the objects.The sound stops once the solar system is able to be rendered. This was done so that a user would not have to listen to the same song constantly looping.

User Manual

Build Instructions

Download the PA7 project folder from the following website, https://github.com/david4jsus/cs480Valenzuela. Open the terminal in the PA7 folder by double clicking the PA7 folder, right clicking inside the folder, and select the open terminal here option. Inside the terminal enter the following commands shown below.

```
mkdir build
cd build
cmake ..
make
```

Run Instructions

After building the project open the terminal in the build folder. To run the project enter the command ./SolarSystemBois into the terminal. As a warning the project takes a moderate amount of time to start running so it may seem like the screen is frozen but the program will run eventually.

Keyboard Input

The camera can be freely moved throughout the solar system using keys on the keyboard. Below is a list of keys which control camera movement. Figure 4 shows different views of the solar system which was done by moving the camera.

W: Move forward
S: Move backward
A: Move left
D: Move right
Q: Move down
E: Move up
Up arrow: Rotate view upwards
Down arrow: Rotate view downwards
Left arrow: Rotate view left
Right arrow: Rotate view right

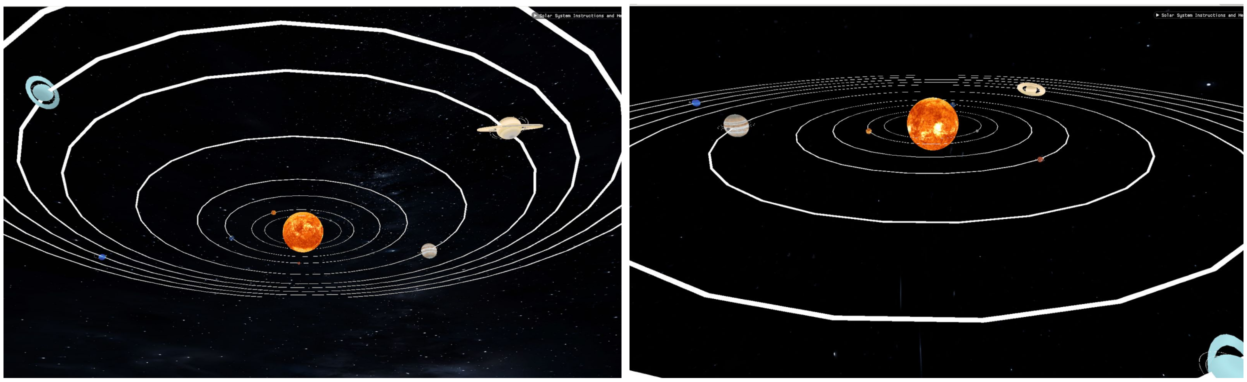

Figure 4. The picture on the left presents a view of the solar system from beneath the planets. On the right side is a picture of the solar system from a view above the planets.

Mouse Input

The user is able to use the mouse to click on buttons within a menu inside the solar system simulation program. The menu contains buttons which allows for specific sections of the menu to be collapsible. This was done to help organize the appearance of the menu. There are four different sections of buttons which have different effects when clicked. One section reverses the rotational and orbital direction of all planets and moons. A second section allows for an increase or decrease of orbital speed for all planets and moons. The third section increases or decreases the rotational speed of all planets and moons. The last section contains buttons which teleport the camera to the position of a planet or moon when clicked. Each button is labeled accordingly indicating what occurs when clicked.

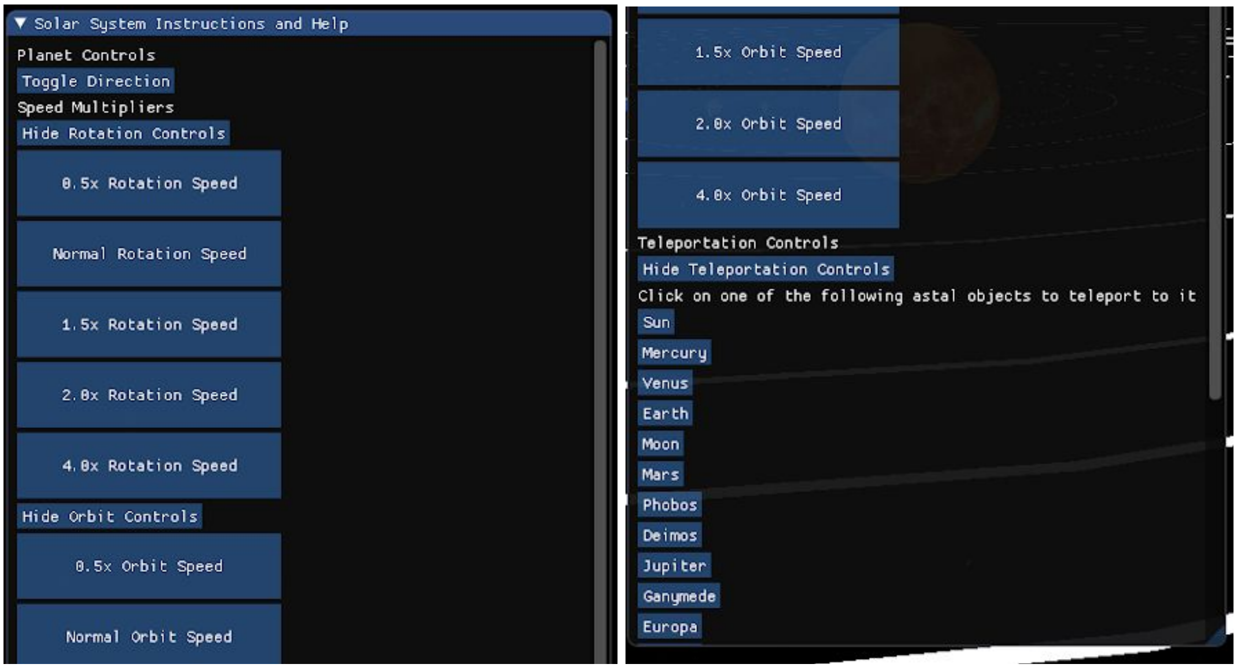

Figure 5. The left image shows the clickable buttons for the top half of the menu. The image on the right shows the bottom half of the menu.

Technical Manual

Issues

On the date of submission, 10/18/2018, there were no issues with our project. One issue we encountered during implementation is that all textures were upside down on our objects. This was caused because assimp and blender use different v coordinate positions for their respective uv coordinate system. To fix this issue we had to change the sign of the v coordinate by multiplying it with negative one. Another issue occurred when clicking a button to teleport the camera to the position of a moon. Clicking a button would move the camera back to the middle of the solar system, at the position of the sun. This issue occurred since the camera used the translation of a moon when it moved away from a planet. Each moon starts at the position of a planet and then translates itself to get a new position. To fix this issue we added the translation of the planet to the moon.

Changes

A few changes have been implemented since the date of submission, including the addition of orbit paths, sound, and a redesigned menu appearance. There are now white rings which show the full orbital path for each planet and moon. These rings make it easier to detect planets and moons and also can be used to determine where they will move towards. Sound adds to the overall experience and enjoyment of running the solar system simulation program. The redesigned menu appearance helps to organize buttons within the menu.

Thing we would have done differently

There is only one thing we would have done differently. We would have made a config file which would scale all the planets and moons in relation to each other. Currently we are using a data file which gets all the information for each planet and moon. From the data file planets and moons can have individual parameters changed such as size, orbital speed, orbital radius, and rotational speed. Creating a config file would have allowed for scaling of the entire solar system instead of having to scale each planet and moon individually.