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INTRODUCTION TO COMPUTER GRAPHICS

Final Project

Solar Eclipse

Description:

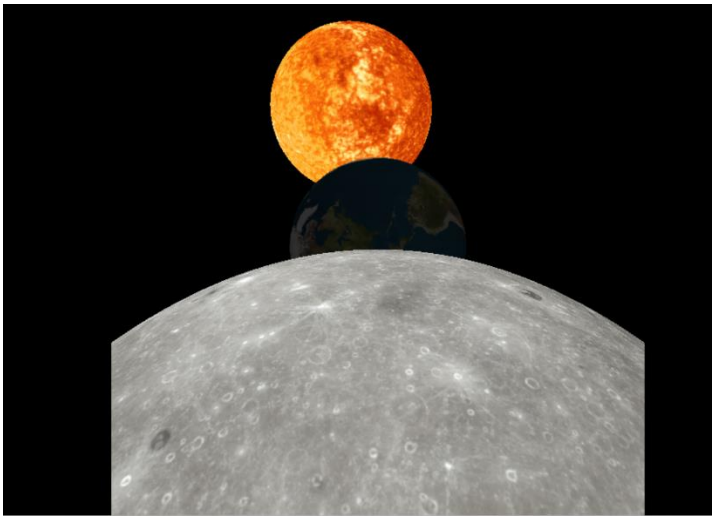
This project showcases a detailed solar eclipse simulation using OpenGL, presenting a dynamic representation of the Sun, Earth, and Moon with accurate rotational movements, textures, and lighting effects. The key highlight of this project is the ability to simulate a solar eclipse by dynamically controlling the Sun's light source and observing its impact on the other celestial bodies. The included visuals demonstrates the accurate alignment of the Earth, Moon, and Sun during an eclipse event. For the simulation, textures were sourced from NASA's database, resized, and converted into BMP files to ensure compatibility with OpenGL. Each celestial body is carefully scaled and positioned to maintain proportionality and realism. The Sun is displayed prominently with a glowing texture to emulate its radiance, and its light source can be toggled interactively: pressing 'L' turns the light off, simulating an eclipse, while pressing 'S' restores the lighting. This interactivity allows users to observe how the absence of the Sun's light affects the visibility of the Moon and Earth in real-time.

The project also features multiple viewing perspectives: an external view showcasing the entire system, an Earth-centered view ('E'), and a Moon-centered view ('M'). These perspectives are seamlessly integrated, allowing users to explore the solar eclipse from different vantage points. The orbits of the Moon around the Earth and the Earth around the Sun are represented with exaggerated spacing for better clarity, while the precise mathematical calculations in the code ensure accurate rotations and alignments.In terms of planetary properties, the Earth's tilt angle (23.44 degrees) and orbital radius are accurately represented using scaling factors derived from real-world data. Similarly, the Moon's orbit includes its 5.14-degree inclination and an orbital radius relative to Earth. These details are calculated and integrated using mathematical transformations and matrices in the code, ensuring scientific accuracy. The use of OpenGL's lighting and texture-mapping features further enhances the realism, with dynamic shadows and smooth transitions in brightness.

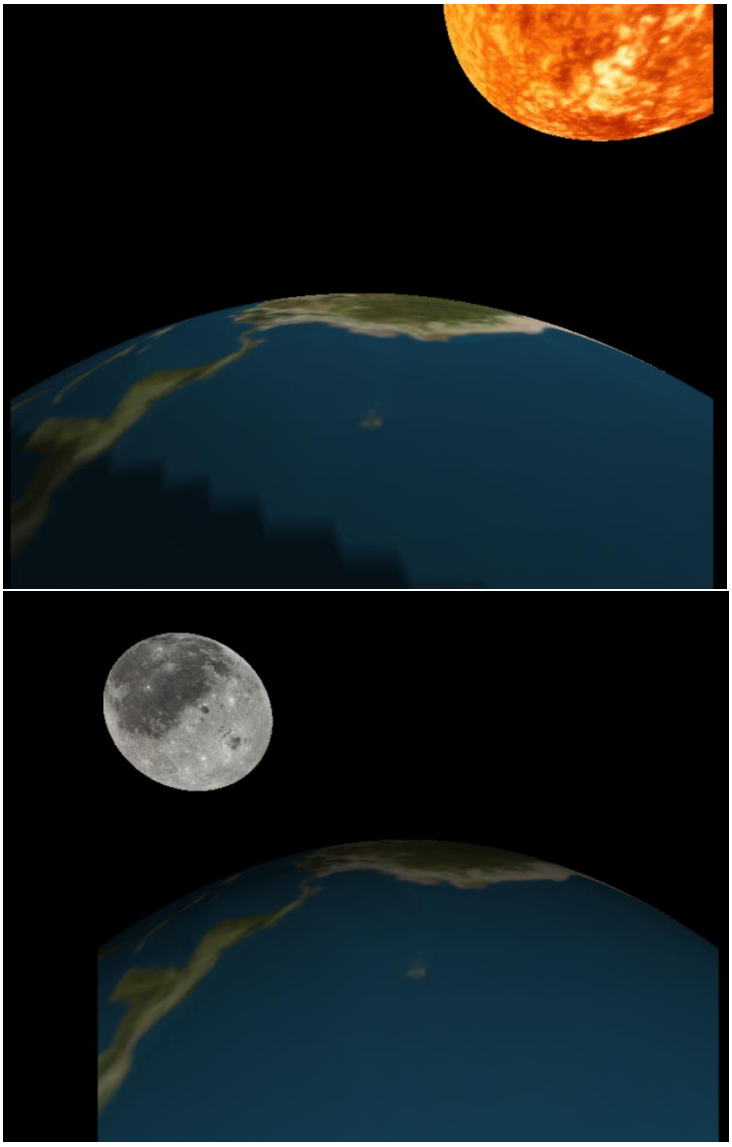
The project also highlights the use of interactivity with keyboard controls, allowing users to manipulate the simulation effortlessly. The axes of rotation, scaling factors, and lighting properties are adjustable in real-time, enabling a highly customizable experience. The system demonstrates a combination of orbital mechanics, texture mapping, and interactive 3D rendering, showcasing the power of OpenGL for educational and scientific simulations.

Overall, this project serves as a visually engaging and technically accurate representation of a solar eclipse, emphasizing the interplay between light, motion, and perspective. It not only illustrates the mechanics of an eclipse but also provides an immersive platform for users to understand and appreciate the celestial dynamics of our solar system.

Output:

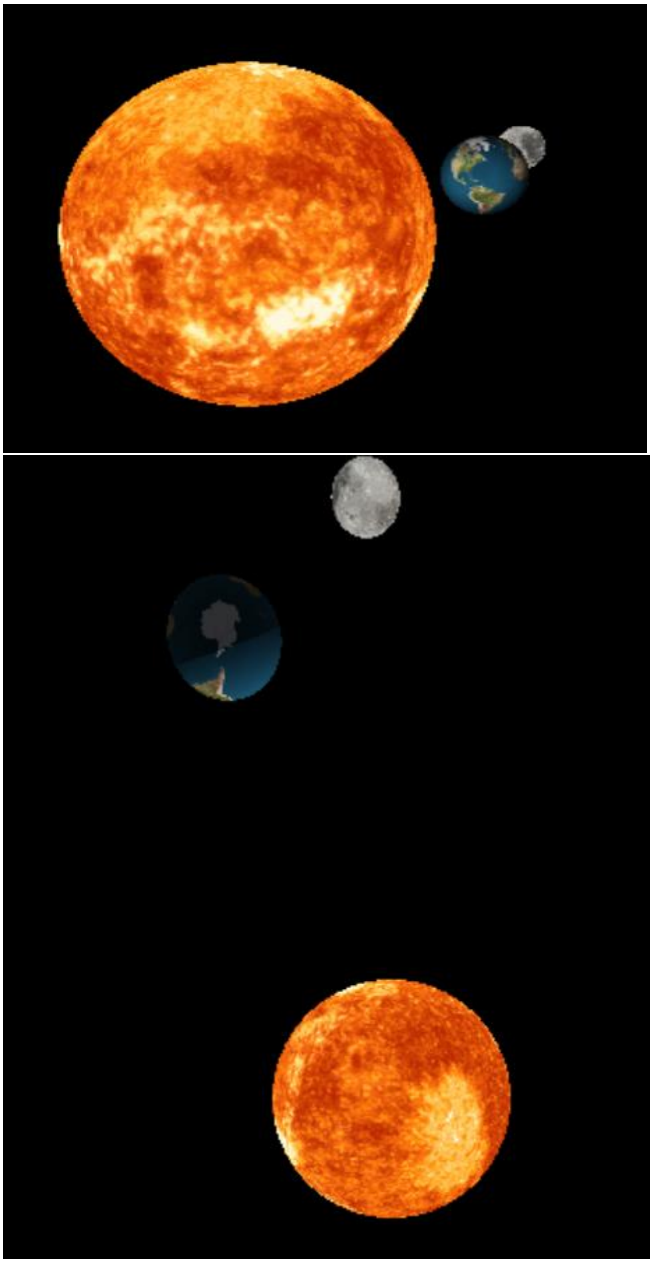


In this image, I have successfully simulated a solar eclipse where the Moon perfectly aligns with the Earth and the Sun. This perspective is captured from the Moon's surface, showcasing the realistic textures and lighting effects that I implemented in my project.



In the first image, the Sun is prominently displayed, showcasing its glowing texture, with Earth visible in the foreground, capturing the dynamic relationship between celestial bodies. This view emphasizes the central role of the Sun in the solar system.

In the second image, the Moon comes into focus alongside Earth, providing a striking representation of their proximity and relationship. This perspective highlights the realistic textures applied to the Moon and Earth, demonstrating the intricate orbital mechanics between these two celestial bodies. The simulation brings forth the Earth's curvature and the Moon's detailed craters, enhancing the visual realism.



These images represent the solar eclipse simulation, which I developed as part of my final project using OpenGL. The first image demonstrates the alignment of the Sun, Earth, and Moon during the eclipse, showcasing how the Moon casts its shadow over the Earth. The second image emphasizes the distinct spatial arrangement of the celestial bodies, providing a clear depiction of their positions during the eclipse.

For the project, I used realistic textures obtained from NASA, adjusted their resolutions, and converted them into BMP format for compatibility. Dynamic lighting enhances the visual realism; users can toggle the Sun's light using keyboard inputs ('S' to simulate darkness and 'L'

to restore light). The simulation includes exaggerated orbits for improved visibility and features rotational animations for each body. This interactive model vividly demonstrates the mechanics of a solar eclipse while offering both Earth and Moon perspectives to fully appreciate the phenomenon.

Kaltura link :

https://media.oregonstate.edu/media/t/1_5f39ub0e