Project Write Up

SOLAR SYSTEM IMPLEMENTATION IN BLENDER

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Introduction

The illustration of the Solar System in Blender implementation will be presented and discussed in the given project report. The general idea is to develop a model that can take the approximate positions, masses and velocities of some planets and illustrate a realistic picture of the Solar System.

As these planet's movements/motions are very hard to be captured from a real-time camera, computer graphic techniques can be utilized and equipped as another solution to generate the same expected frame of a planet's movement. Blender is a program designed for any type of movie graphics. It has many lighting and angle capabilities, as well as a three-dimensional coordinate system.

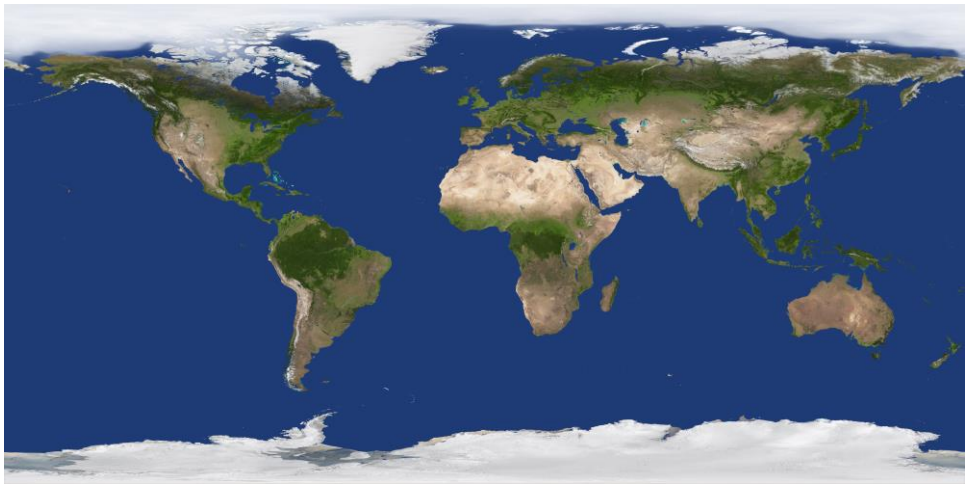
This report outlines the methods used to visualize the artificial Solar System and presents a short animation (10 sec.) of created Solar System as a final achievement of the project.

- **Objects**

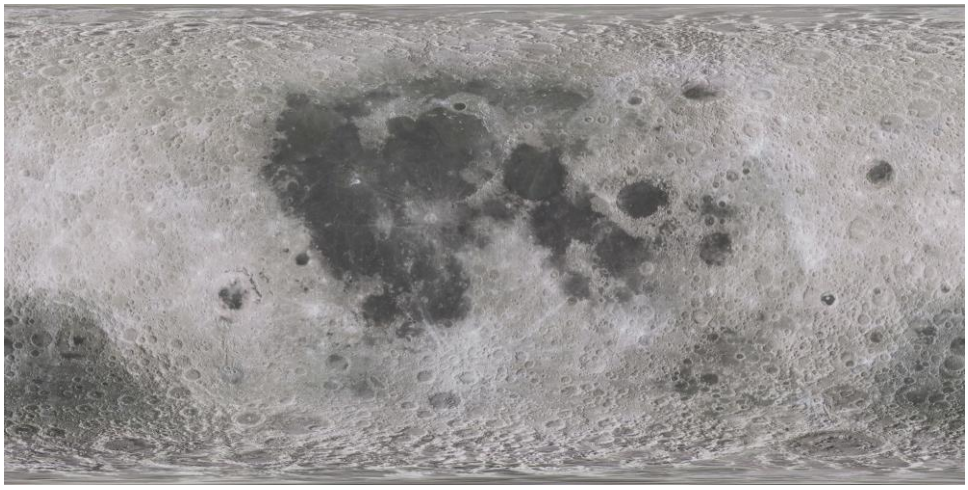
The Solar System is the planetary system with the sun and planets. There are eight planets in total that orbit the Sun. For the given model implementation three planets have been taken as well as the Moon and the Sun.

Texture

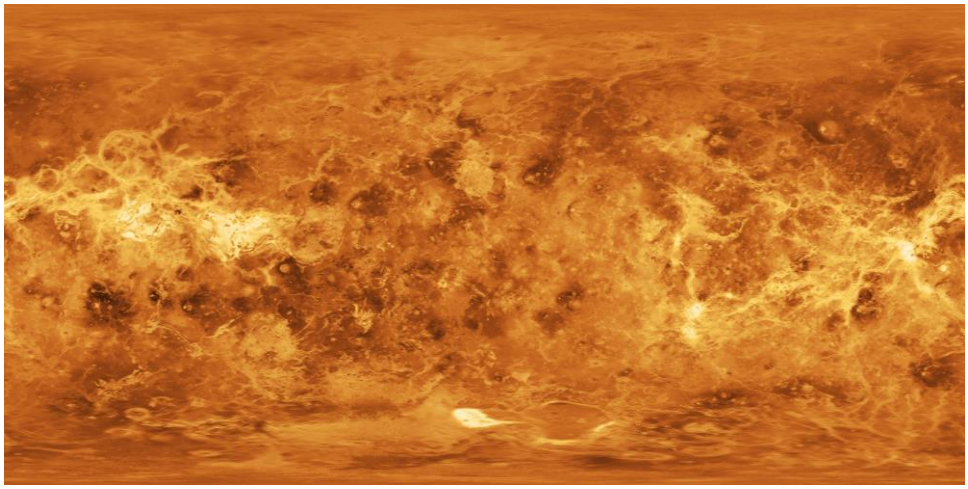
Initially, the planets are simple UV spheres. Materials of the planets have been taken as an Image Texture from the internet [1].



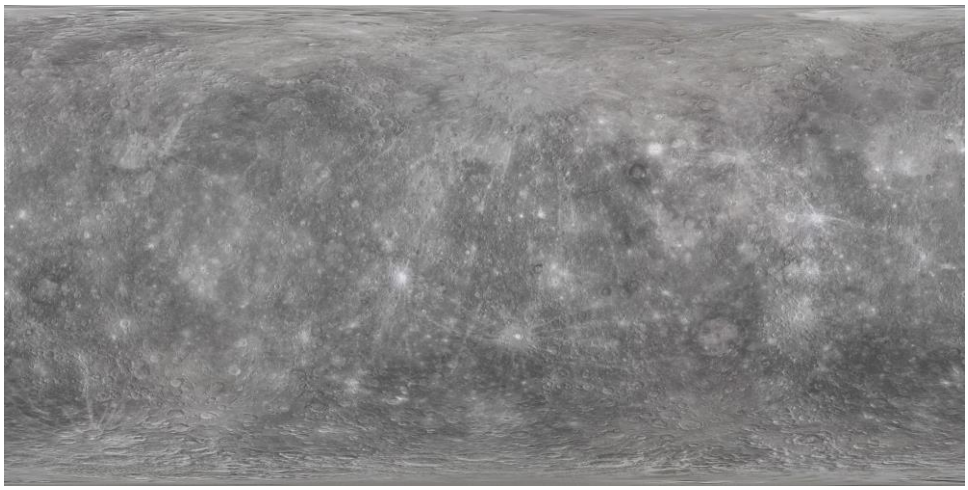
Earth



Moon

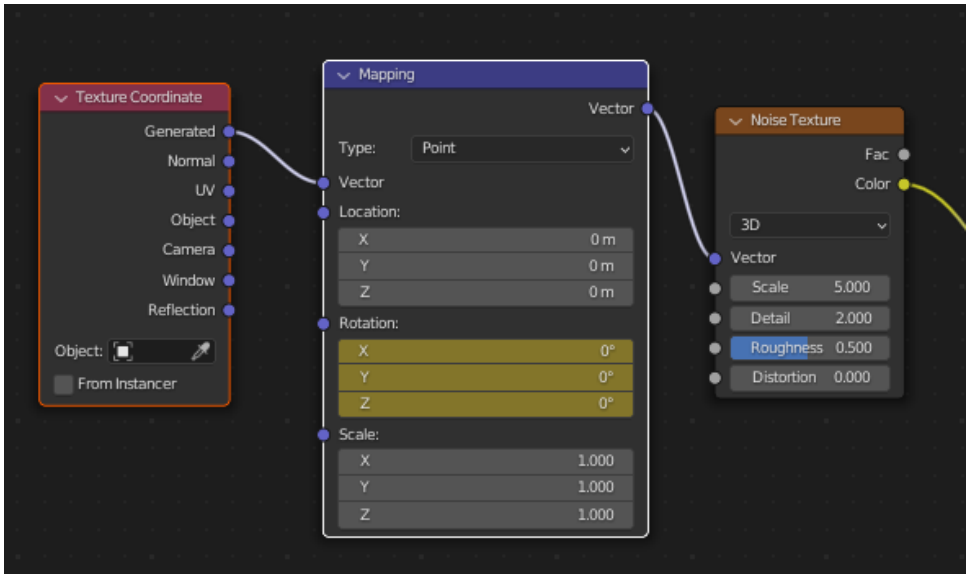


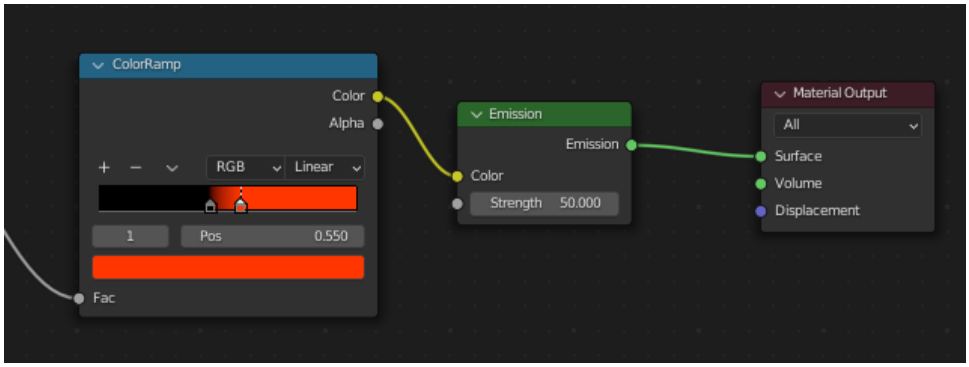
Venus



Mercury

In the middle of the scene – Sun, I chose a specific material to represent it. This is a yellow color material with *Bloom*, *Ambient Occlusion* and *Motion Blur* effects on. Further improvements have been made in Shader Editor:





Rotation

Since the Sun is located in the World Origin I can set the Origin of each of the planets to the "Origin to the 3D Cursor", by that I will be able to rotate the planets in the orbit around the Sun. Different settings are applied to the Moon since its orbit is located around the Earth. Thus the World Origin should be set in the middle of the Earth.

The table below shows the actual parameters for the planets but for this project I took the approximate values for the distance from the Sun, diameter, rotation time, and speed:

	MERCURY	VENUS	EARTH	MOON	MARS	JUPITER	SATURN	URANUS	NEPTUNE	PLUTO
Mass (10^{24}kg)	0.330	4.87	5.97	0.073	0.642	1898	568	86.8	102	0.0130
Diameter (km)	4879	12,104	12,756	3475	6792	142,984	120,536	51,118	49,528	2376
Density (kg/m^3)	5429	5243	5514	3340	3934	1326	687	1270	1638	1850
Gravity (m/s^2)	3.7	8.9	9.8	1.6	3.7	23.1	9.0	8.7	11.0	0.7
Escape Velocity (km/s)	4.3	10.4	11.2	2.4	5.0	59.5	35.5	21.3	23.5	1.3
Rotation Period (hours)	1407.6	-5832.5	23.9	655.7	24.6	9.9	10.7	-17.2	16.1	-153.3
Length of Day (hours)	4222.6	2802.0	24.0	708.7	24.7	9.9	10.7	17.2	16.1	153.3
Distance from Sun (10^6 km)	57.9	108.2	149.6	0.384*	228.0	778.5	1432.0	2867.0	4515.0	5906.4
Perihelion (10^6 km)	46.0	107.5	147.1	0.363*	206.7	740.6	1357.6	2732.7	4471.1	4436.8
Aphelion (10^6 km)	69.8	108.9	152.1	0.406*	249.3	816.4	1506.5	3001.4	4558.9	7375.9
Orbital Period (days)	88.0	224.7	365.2	27.3*	687.0	4331	10,747	30,589	59,800	90,560
Orbital Velocity (km/s)	47.4	35.0	29.8	1.0*	24.1	13.1	9.7	6.8	5.4	4.7

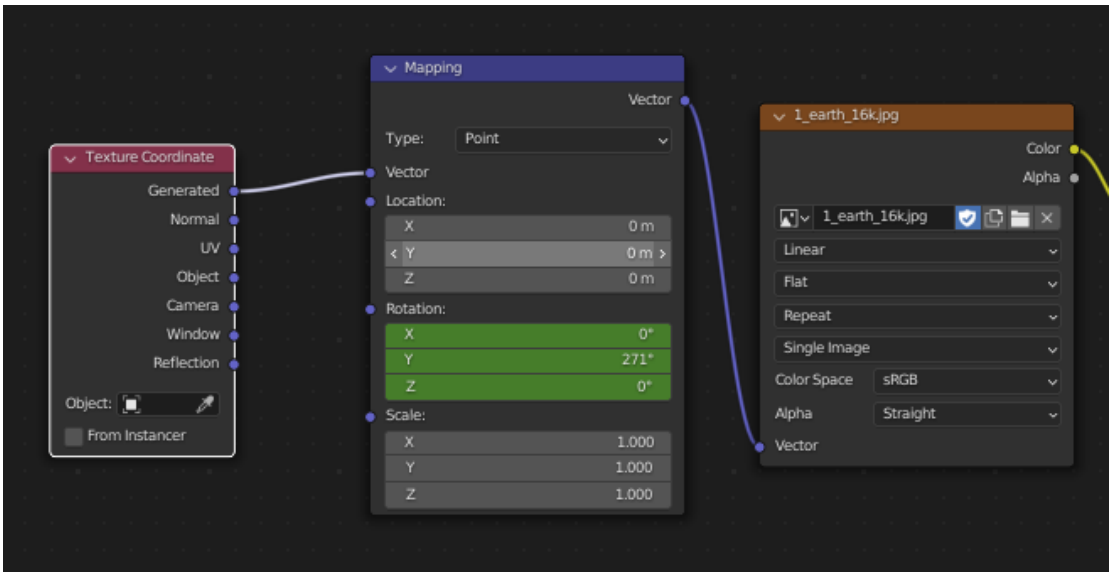
Planetary Fact Sheet – Metric [2]

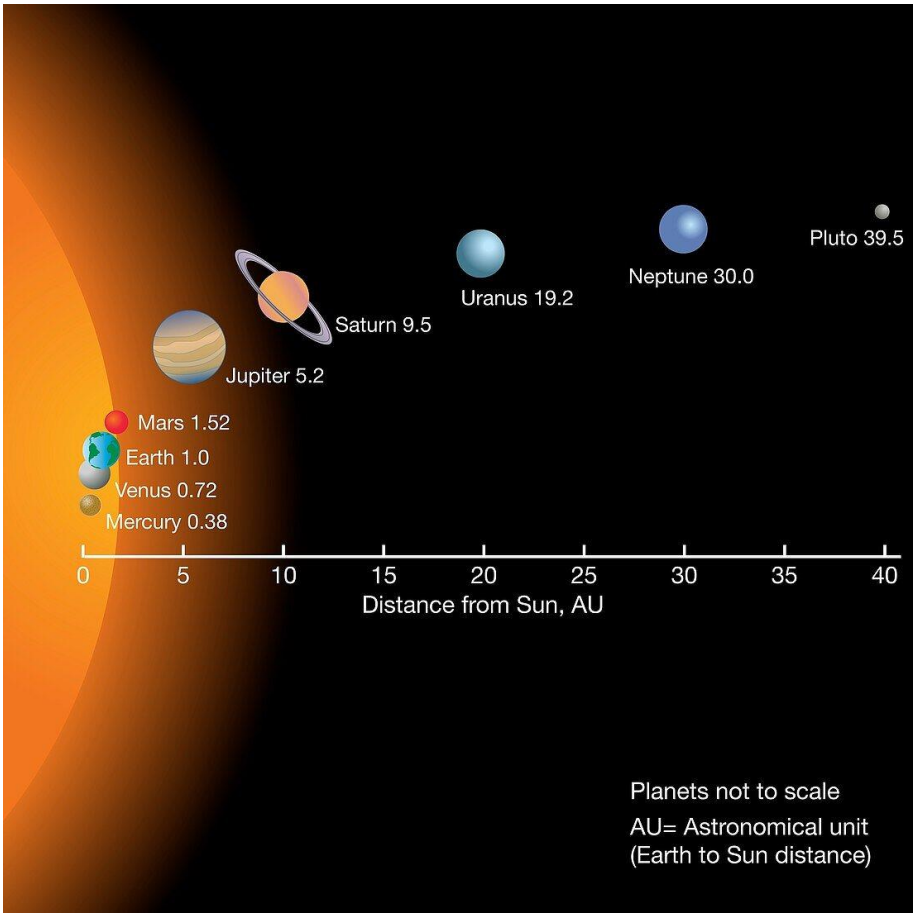
The parameters for the planets of the scene are presented in the table below (the interpolation is set to Linear for each planet):

Sun	Mercury	Venus	Earth	Moon

Rotation period (Y axis)	360	720	720	360	360
Orbital period (Z axis)	-	4 rot. (4 * 360 = 1440)	3 rot. (3 * 360 = 1080)	2 rot. (2 * 360 = 720)	7 rot. (7 * 360 = 2520)

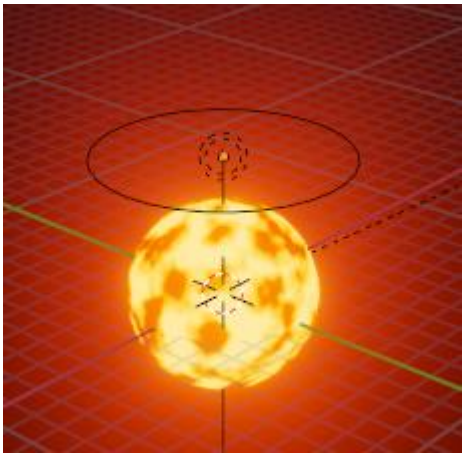
The rotation around the Y-axis of the planets (around itself) can be done in the following way for each of the planets but with the different values (can be seen in the table above):





- **Light**

To represent how the light works in the solar system, the directional light type is selected. With directional light, the planets will have the lights based on the direction from the light source. The main source of light is set up in the center of the scene over the Sun and illuminates all the other planets. It makes the effect of the Sun lighting to the planets. The Area light has the shape of a disk and power of 4500 W which makes it possible to light the distant elments of the scene.



- # Blender result

The obtained video of 10 seconds captures all the developments which I described above. The overall issue of the work with Blender for me was only my lack of experience. The right movement implementation, texture and light initialization cause huge time spent. Rendering a two-dimensional image taking into consideration 3D objects, virtual camera and light sources take a lot of effort to make it acceptable for presentation.

For the planets it is not sufficient to apply just a shape and color, some additional properties should be initialized, for instance, high-quality image textures, which also require a lot of memory. Adding functions such as random noise, and Worley noise can make the material more detailed.

Just correctly installing the light sources can change the whole presentation for a better way considering the fact that lights in general make the picture more realistic. It is necessary to understand what is the right position of light should be set and what type of light should be chosen.

During the implementation, I have been using the data from the lecture slides as well as I found it useful to search on the Internet for more specific aspects of my Solar System project. I hope the resulted video can successfully represent the learned techniques and skills I acquired in the given course.

- # References

[1] Free Solar Textures. https://www.solarsystemscope.com/textures/

[2] Planetary Fact Sheet. https://nssdc.gsfc.nasa.gov/planetary/factsheet/

[3] Tutorial - How to make 3D Animation of Solar System easily using Blender software.