Galaxy Tour

Educational Visualization of Space

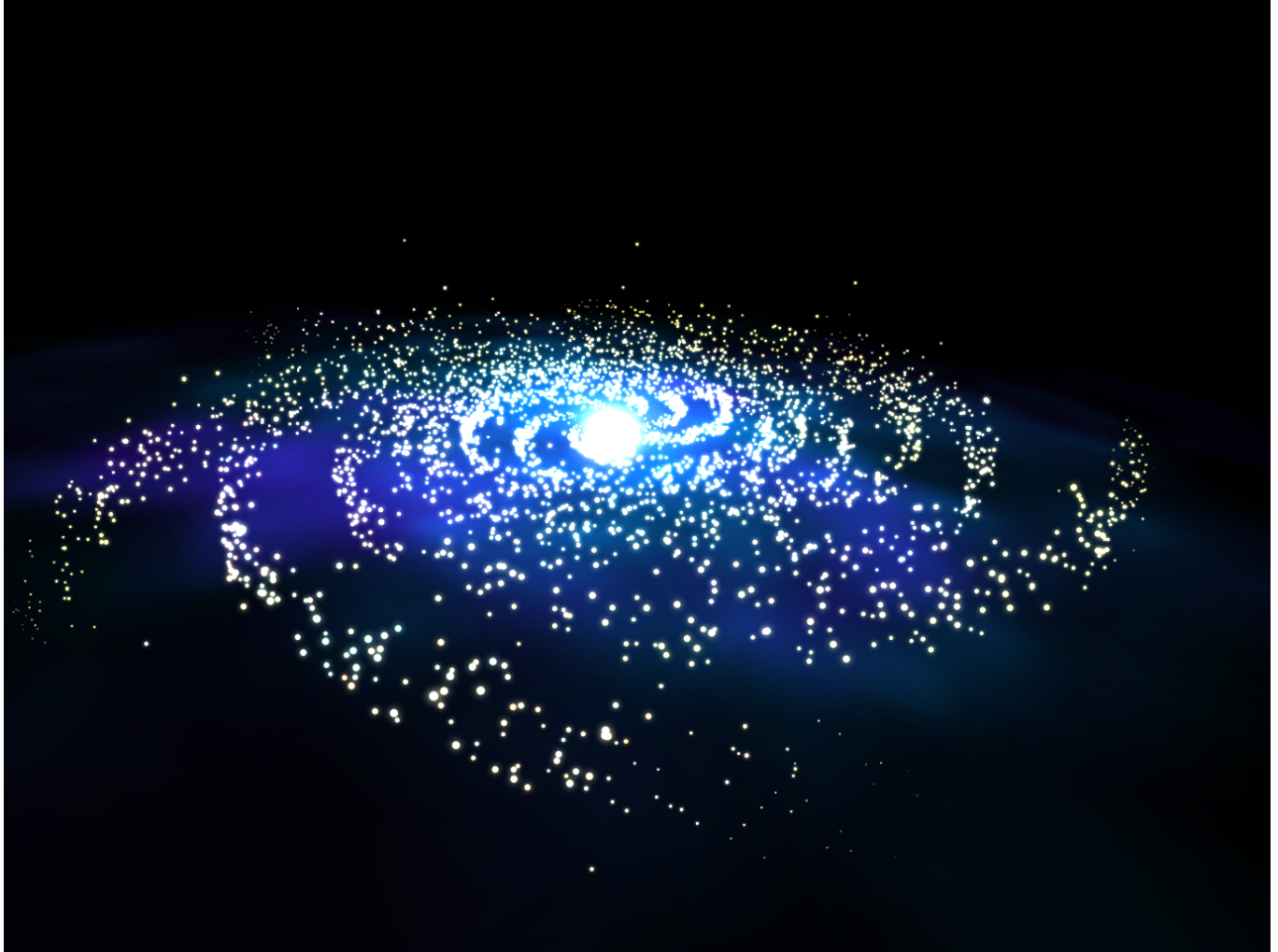NATALIA ABROSIMOVA and WENQING LAN, University of Washington

Fig. 1. Galaxy

Galaxy Tour is simple educational tool based on the Galaxy Explorer by Microsoft and Map from Treasure Planet. We focused on 3 scenes - star chart, solar system and galaxy.

1 INTRODUCTION

Galaxy Tour is one of the early applications for educational use. It is easier to understand how something works when you get to see the immersive visualization. We also wanted the visualization to feel realistic and exciting to the user. We

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began with excitement over trying to partially reproduce elements of the scene from the Treasure Planet when the main character opened the map and was fully immersed in the 3d map of space. Each scene that we created are layered similar to the textbook. First we start with stars around us, as we are on the Earth. Then we progress to the Solar System, and only then to the level of galaxy.

1.1 Contributions

- The main contribution is a project itself. This is a smaller version of Microsoft Galaxy Explorer. The second contribution

is rendering of visualizations of stars, planets and etc using particle systems and spheres.

- And third contribution is processing of data from star database.

2 RELATED WORK

Our idea was previously implemented by Microsoft as an application called The Galaxy Explorer. They created a full experience, showing off galaxy, solar system and even the inside the earth. They also were able to provide information display about each element. Unfortunately we were not able to try out the project ourselves, however the videos we would on YouTube showed well thought out design and graphics. We also read through John Kennedy's medium article on display of Virtual Sky. This article gave us starting idea about where to start with night sky.

3 METHOD

We decided to divide the project into 3 parts - 3 scenes. First one, the star night, however we wanted the person be the center with no ground to cover up stars under horizon. Second part, was scene with solar system. And third, you see a galaxy. This is a logical 3 step visualization of layers. Then we had to find a way to transition between scenes.

4 IMPLEMENTATION DETAILS

For stars we used the hyg dataset, that we parsed. The reason why we chose hyg database is because we need to have estimated position of the stars and be able to parse it. We used index and magnitude to estimate the size and color of stars After which we created the particles around the center with estimated size and color. There is not much information about how to parse the coordinates or other about color and size. We end up implementing sparkle effect where stars are not not always present and change lightness once in a while to look like it is sparkling.

For the Solar system, we utilized the specific movements of the particle system and the information of basic transformations. The sun itself was created with a sphere plus multiple particles that are emitted from the center and stopped at the shell to form the dynamic flow and wind. The hardest part was figuring out how to draw the orbits. So, to make the basic rotation works, we used rotation transformations on each planet. And to show the orbiting more clearly, we draw out each orbits by setting up a point at the sun and using the distance between the sun and each planet. We also have a functionality that if you click on a planet with mouse, it will zoom in and follow the planet as it circles around. The speed planets match the speed in km/s in real life. And the textures for planets are downloaded from the asset store.

For galaxy, we had to draw clouds so we photoshopped a texture to create cloud/fog like image. we also created materials for particles from scratch. The particle speed becomes slower when closet to the outer edges. We considered adding a force field to represent the motion of galaxy, however we chose to divide it into multiple components stars, clouds and core in the middle.

To make the transition between scenes feel smoother we added animation of fade-in effect. Player can transition using x button

on controller or space button when not using Quest. Originally we were planing to add buttons and add controller functionality to press them, however when we implemented it, we noticed that it kills overall effect of the scenes. So we replaced that with pressing x button instead.

5 EVALUATION OF RESULTS

We showed videos to some users over zoom, and got positive feedback that they would like to try it out in VR environment. We tried to get feedback at multiple stages of development. For example, the first galaxy version that we had was characterized dying because too many particles are flying away from galaxy when Milky way is not. Another one was that rotational speed of planets is too high to look at so we slowed them down for better visual effect. Those who tried in vr felt that they would like to see the ability to interact with objects. We were not able to let many people try it due to current situation. At the end, we tried to implement the ability to walk around however ability to walk around did not the experience better, it felt unnatural to walk around the planets while they are rotating and moving through galaxy. Also, the sky scene was stationary scene and changing the experience from scene to scene was confusing to the user. So we deleted that part of experience, and decided to limit it to stationary experience.

6 DISCUSSION OF BENEFITS AND LIMITATIONS

We wanted to make visual representation of space that will be interesting to younger generation and inspire their learning. A 2D representation lack clarity when it comes to 3D models, they cannot show the speed of stars nor how they would look if you could see all the stars around you as if earth was see through. Our application has limited functionality due to limited time and lack of prior knowledge, we could have added some descriptions or explanations as future works. Another limitation is VR technology itself, after long use of vr headset, the eyes can start to feel dry and disorientated. We also understand that the cost of headset is too high for teachers in middle school to provide one for each student. Having one per classroom is more reasonable, but it won't be as effective.

7 FUTURE WORK

We were thinking about adding scene where student can see different types of galaxies. That way they could compare how they look and function in one space. We also wanted to add more elements to solar system, like asteroids belt. And the orbits should be changed to ellipses, and galaxy shadows should be fixed as well. Overall, our application is expendable, it can teach about types of stars, student could watch creation of galaxy, or evolution of planet.

8 CONCLUSION

We believe that VR can become a wonderful way to get students get interested in learning about astronomy and space. Though this application can be helpful but to creation of similar applications for other subject will be difficult for some teachers and providing content for entire K-12 education might not be ideal choice. Therefore, we believe that it is better to provide an easy interface for teachers to create their lessons. However, we can see our application to also

be used for meditation. The calming effect of observing space in isolated environment without visual distractions makes this perfect application for those who want 5 minutes to relax.

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