

Simulated Exhibit Experience

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Abstract — The Orlando Science Center contains a plethora of exhibits that teach visitors about the many aspects of science. However, with the addition of new exhibits, older and less popular ones need to be replaced. Thus the OSC would like to have an online virtual replica of their exhibits. The Simulated Exhibit Experience, or SEE, created in Unity 3D Engine, is a simulation that recreates the OSC and will be accessible for free to the public on the OSC website.

Index Terms — OSC (Orlando Science Center), SEE (Simulated Exhibit Experience)

I. Introduction

The Orlando Science Center, or OSC, is a private non-profit organization and is one of America's top interactive learning science centers, located in Orlando, FL. The OSC provides learning experiences for visitors including: field trip opportunities, family science nights at schools and community centers, and other outreach programs. The OSC is continuously updating their exhibits but is limited by the available space at the center and sometimes must remove exhibits. Some of the exhibits being replaced are adored by some visitors so the OSC would like to have a virtual replica of those exhibits. This provides visitors the same learning experience while clearing valuable floor space. Sponsored by Presagis, a modeling and simulation company, our project is a virtual simulation in the Unity 3D Engine, which recreates the OSC and its exhibits. Besides the exhibits, the Simulated Exhibit Experience, or SEE, also includes a lobby section in which users can see a digital version of the lobby and bridge. The simulation currently contains 3 sections: the Lobby Center, Gravitron and Pinewood Derby.

II. Lobby Center

The Lobby Center serves as a central portal hub to all the exhibits within SEE allowing users to transition between them. The Lobby Center also serves as a

beautiful starting point to the simulation. The final model was easily recognized by testers familiar with the OSC. We started out with a dome-shaped prototype (Figure 1) to be the foundation for other functionalities.

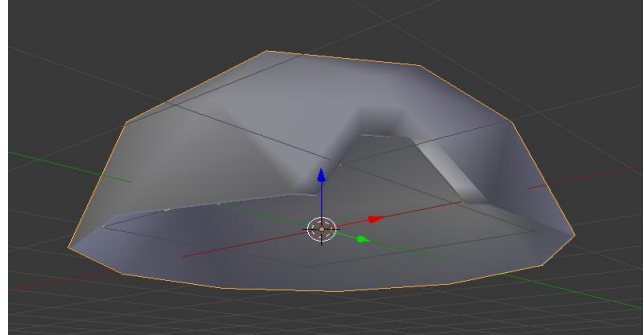


Figure 1: The simple dome-shaped design. The idea was to encase the overall layout of the Lobby Center.

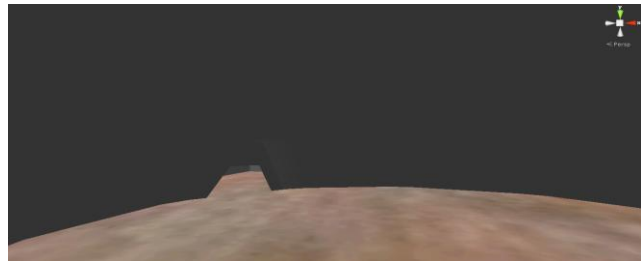


Figure 2: The interior of the dome-shaped design.

As shown in Figure 2, the edges are too smooth on the inside of the dome-shaped design for the users to orient themselves. We realized that the layout was not quite what we need so we transitioned into the next prototype.



Figure 3: The second prototype, showing a circular room with doors on the wall and columns surrounding the center.



Figure 4: The second floor of the second prototype.

The second prototype as shown in Figure 3 and 4 looks much nicer and makes it easier to distinguish the distance between each set of doors and the decorative environment. However there were some clipping issues when walking up the ramp to the second floor.

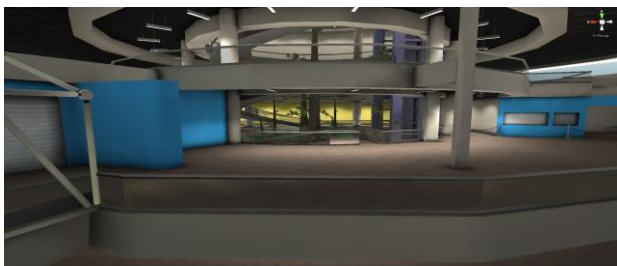


Figure 5: Shows the third prototype by Chris Culverwell (Presagis) of the Lobby Center.

The updated model of the Lobby Center is almost identical to the real life OSC (Figure 5). Since the two functions of the Lobby Center are to connect to the other exhibits and to look nice, it was easy to copy over the scripts from our prototypes.

The Lobby Center contains the Pause Menu script, which handles pausing the simulation when the user presses the escape key as well as prompting the user whenever they click or collide with a door.

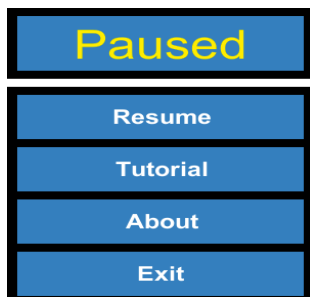


Figure 6: The Pause Menu. Each option is self-explanatory and the menu is accessible at any time during the simulation. For specific exhibits, there are some additional options.

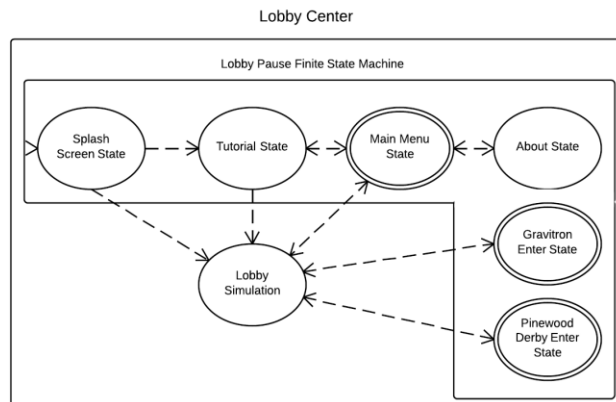


Figure 7: The finite state machine for the Pause Menu in the Lobby Center. The starting state is the Splash Screen which is shown to the user when they first enter the simulation. While active in the Lobby Center, the required conditions to go to each state depend on which option in the Pause Menu the user clicks on (for example: Resume → Lobby Center, Tutorial → Tutorial State, About → About State, Exit → Main Menu State).

III. Gravitron

The Gravitron Exhibit is an exhibit at the OSC that allows visitors to place a series of tubes on a magnetic wall to get a ball from one end to another. Visitors soon realize that gravity plays an important role in how they are designing their layout, which is the goal of the Gravitron Exhibit. The virtual replica of the Gravitron feels very similar to the physical version, with some additional features (such as different Challenges, different Ball types, and Buttons for initiating certain events). The Button objects are very important to the virtual version of the Gravitron Exhibit since they automate actions, such as removing all tubes from the wall, that are normally very time consuming in the real world. These actions are activated only by the user rather than scripts that wait for certain conditions to be true.



Figure 8: The Gravitron Exhibit at the OSC. Major components include: Tubes, Ball, Gutter, Goal, and Magnetic Wall. The virtual version contains these same major components in order to properly replicate the experience.

We referenced Figure 8 when creating the models in Blender (see Tools section) to ensure accuracy in the virtual simulation when compared to the OSC.

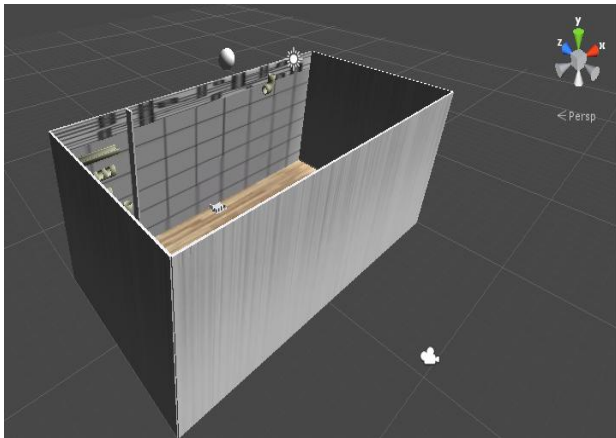


Figure 9: The first prototype of the virtual Gravitron Exhibit.

The main purpose of this prototype (Figure 9) was to get the Ball, Magnetic Wall, and Tube interactions working properly. The plan was to implement unit testing by working on a portion of the major components and

thoroughly testing them as a set before moving to the next set of components. Aesthetics were not as important in the first prototype since that would have required extra time.



Figure 10: The second prototype of the virtual Gravitron Exhibit.

The second prototype (Figure 10) shows a more visually appealing Magnetic Wall as well as three Buttons (Clear Wall, Drop Ball, Challenges). The Clear Wall Button calls a script to delete all the Tubes on the Magnetic Wall if the user has placed any. The Drop Ball Button will instantiate a Ball object at a fixed point on the top right corner of the Magnetic Wall and change the camera perspective to follow the Ball. For this prototype, the Challenges Button was not functional.

We brought this prototype to Otronicon, a convention held at the OSC featuring simulations and educational games. We were able to get feedback from visitors of all ages which helped us to find bugs and provided ideas for improvements in the next prototype.

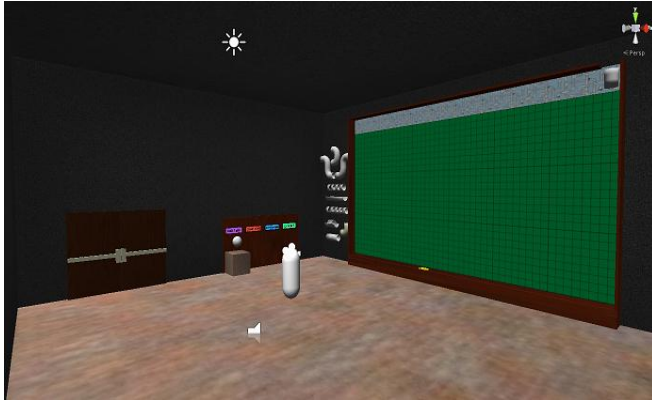


Figure 11: The third prototype of the virtual Gravitron Exhibit.

Figure 11 shows the redesigned room as well as some additional Tubes to provide even more creative freedom to the user. The Challenges Button is working and a new Button, Change Ball, was added. The Change Ball Button allows the user to toggle between Plastic, Metal, and Rubber as the material for the Ball object. These different materials will affect how the ball reacts to collisions and friction and can change how the ball performs in the Tube layout.



Figure 12: The fourth prototype of the virtual Gravitron Exhibit by Chris Culverwell from Presagis.

The final version of the virtual Gravitron Exhibit (Figure 12) looks almost identical to the physical version. The models for everything except the Button objects were upgraded. For this version, the Buttons are located on the top of the Magnetic Wall for the user to see their location at any time while building their layout of Tubes.

IV. Pinewood Derby

The Pinewood Derby Exhibit at the Orlando Science Center allows visitors to construct derby cars and race them against each other. The exhibit uses Pinewood Derby cars to teach visitors about the relationship between gravity, energy, and motion and how those principles can be applied to construct a winning derby car.

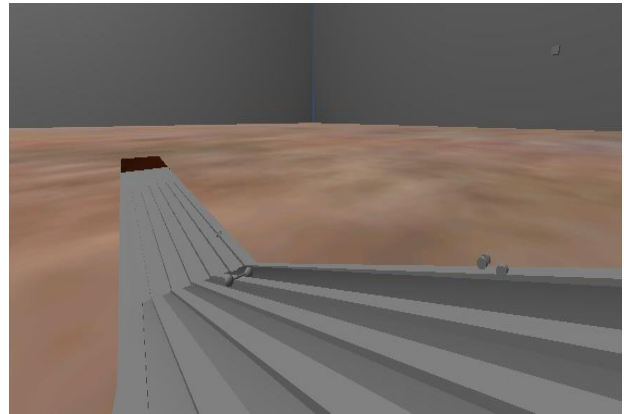


Figure 13: The first prototype of the virtual Pinewood Derby.

The first prototype (Figure 13) was a simple room to experiment with the physics of different basic objects (such as a sphere).

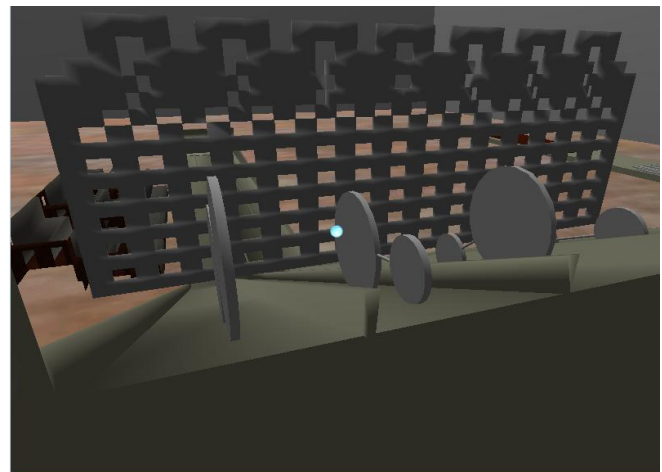


Figure 14: The second prototype of the virtual Pinewood Derby.

The second prototype (Figure 14) used a new ramp with multiple vehicles to determine the correct formulas for calculating the speed and direction of each object.

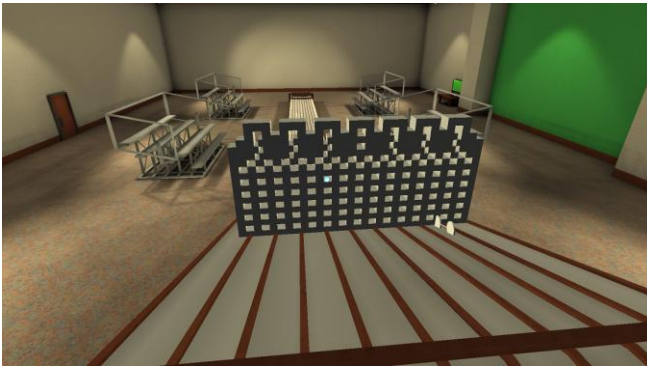


Figure 15: The third prototype of the virtual Pinewood Derby by Chris Culverwell from Presagis.

Though Figure 15 shows the visually complete portion of the Pinewood Derby Exhibit, the functional aspect is still incomplete.

V. Technology

The following tools were used to create SEE: Unity 3D Engine, MonoDevelop, and Blender. Unity 3D Engine is a game development environment that allowed us to create and combine events, scripts, basic objects, and other elements to create a fully functional simulation. Scripts were written in C# within the MonoDevelop IDE that comes with Unity. Blender is a free 3D modeling software that enabled us to create placeholder models for the simulation while we waited for Presagis to provide us with professional art. Our models formed the basis for the upgraded art provided by Presagis.

VI. CONCLUSION

The Simulated Exhibit Experience is our solution for the Orlando Science Center's constant need for more space and preserving popular exhibits. The goal of the SEE is to someday be a complete replica of the OSC, now that we have built the foundation for future developers.

The current fully functional exhibit is the Gravitron. Any additional exhibits will be created in a new Unity scene that is independent from the existing exhibits. The Lobby Center will simply link a Door object to the new virtual exhibits without having to modify anything else.

Acknowledgement

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