Simulations in Hybrid Virtual Reality: UIC East Simulation

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Student Engagement Grant

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Table of Contents

Introduction

With the accessibility of faster CPUs and discrete graphics cards that can handle even the most demanding of tasks we are able to see the industry of both computers and mobile devices grow at an exponential rate. It's due to this growth that we see the emergence of new highly interactive Virtual Reality (V.R.) gear finally arrive in the market. In the few months that I began working on this project both game engines Unity and Unreal Engine began to support (through the use of plugins) VR technology like the Oculus Rift and HTC Vive. Not only do those engines support V.R. but are competing to make the workflow for developing experiences within those respective devices even more simple than it already is. That way the focus is on developing environments and using the hardware to its greatest capability. This is an industry that even tech giants like Google and PlayStation began to show strong interest in my creating their own versions of V.R. gear, through Google Cardboard and PlayStation VR. V.R. allows for the creation of expansive content that immerses the user into the created environment that was not done so in such a depth ever before. The goal of this project was to engage a few students into the technicalities of how this is done and create an environment that showcases the advantages of V.R. That's where "Simulations in Hybrid Virtual Reality" comes in and the name of its final product "U.I.C. Demo".

U.I.C. Demo

This is a path finding simulation that expands on the 2-D university path finder that allows students to observe their route before they are actually on campus, but by translating it into a 3-D Virtual Reality world. The demo prompts the user to choose what building they're trying to find and this simulation will guide the user to that specific building. There is a set path

that is displayed but the user is allowed to roam free inside the environment if desired by simply choosing the option in the title screen. By pressing escape we enter the pause menu, the user can return to the title screen from there if he is lost in the environment during free roam. Otherwise the path is laid out before the user. Only the East Campus is included and it's bounded so going beyond Campus grounds is prohibited. Once the user reaches the destination information on the building is displayed along with a few actual pictures (from Google Maps).

Student Engagement

I discussed before how V.R. was reaching new heights by applying it to different fields such as optometry and stargazing in my initial proposal, and by allowing engineering students to work with such a device exposes them to a new type of industry that is changing the way we literally experience "reality". The goal of student engagement is to enrich the educational experience of students in a particular field of study and expand their understanding of how different components from cross disciplinary fields can be applied to one's final design. I worked together with from Laurentiu Ptanec (a sophomore Computer Science major here at U.I.C.) and Jacob Vodick (sophomore Economics major currently studying at College of Dupage) to complete such a task. Together we discussed how we wanted to go about the simulation, then divided the project into three major parts: Modelling, Movement and Animations, and User Interface. It was when we began developing the game that we realized that conventional ideas used in programming traditional P.C. games did not exactly apply to V.R. programs.

Developing simulations for V.R. is very different than developing for regular 2-D or even 3-D games. One of the most important things that must be considered is how placing the screen directly onto your eyes translates into the game experience. The user interface cannot be simply

overlaid onto the screen since it would be very uncomfortable to have text directly in front of you, we need to account for distances relative to the user and define the world from there. In essence we defined the scale of our world and expanded from there.

The first step was finding models that represented U.I.C.'s East Campus which through the help of The Office of Facility and Space Planning we were able to get basic mass geometries of both East and West Campus (we focused solely on the East side) in a Google Sketchup file. The next step was applying the textures onto these models since at first they were simply white geometrical shapes. We tried a variety of programs like Autodesk 3DS Max and Blender to add textures onto these models since Unreal Engine did not support Sketchup Files nor did Sketchup export them in the ASCII FBX format we needed for the engine. Inside these modelling programs we had to format the UV mapping of these models which could be done pretty easily, but upon importing them onto our (then chosen) game engine (Unreal Engine) proved to be a great challenge. The lighting of the environment was always incorrect and the shading used in 3DS Max never completely transferred over to Unreal. Therefore we decided to change our game engine to Unity which became free a few months after we started the project. This game engine was far superior in terms of integration from different programs since it offered a direct import method from a Google Sketchup file. We simply added the textures into the models in Sketchup then imported into Unity (where we had no such problems with the lighting and mapping of the environment). With that we could focus on the V.R. character's movement inside the environment.

Modelling was by far the hardest hurdle in our V.R. project since in our group we had little knowledge of 3D modelling programs (we used numerous tutorials and reference sites like Lynda to gain a firm understanding on these programs), but when it came to generating the

scripts that ultimately defined the V.R. character's movement we completed this task far more quickly. We used a visual mapping plugin that was available for free on Unity to decide the paths that the user would follow. We simply named each path according to the building it corresponded to. The user would be given the option to choose (there are buttons displayed on the screen) where they would like to go on East Campus and their selection would take them there. Thus, we arrive to the final step in our program. Creating the User Interface.

The User Interface (U.I.) was unique in V.R. since we had to consider alignment of things relative to the user. Therefore we decided the best approach would be to create a "Main Menu" level that had a large screen in front of the user and they could choose the option they desired by using the mouse. This way not all the text is shown on the screen at once, but the user could still see all the selections by simply moving their head. Since this is also my Honors Activity for this semester I am cleaning up the User Interface there is a smoother transition from the "Main Menu" to the "Campus Environment" so that if loading assets does take some time to execute the user is not left in front of a very dark screen. Remember the user can only see what's on the screen since it covers both eyes. Also, I was experimenting with different modes available in Unity for scenes like ambient occlusion, anti-aliasing, and linear/HDR to see if it could perhaps improve the overall look of the models. In future endeavors, I would definitely start my modelling in 3DS max since it offers greater control over the geometry of 3D shapes, however for this project the large number of buildings that had to be dealt with and the necessity of correct mapping of distances in relative to each building made the given Sketchup file the better choice. We wanted to make the distance as accurate as possible, that way the program was an accurate representation of U.I.C.'s East Campus.

Project Conclusion

To be able to translate a simple path finding program and expand it to a 3D virtual reality project that incorporates the use of numerous scripts and assets from many different programs like Autodesk 3DS Max and Google Sketchup and integrate them into a game engine that puts all of these components together to make a working V.R. simulation has been a arduous challenge and enriching experience. To be exposed to different industry standard modelling programs and understanding how these programs can increase the speed of developing, but at the same time may require more time exporting it into a different program. As a group we also faced issues like light mapping and changing the U.I. to better fit V.R. and it's by actually doing such procedures that we were able to see what kinds of problems would arise and how to resolve them. The V.R. gear that is coming out in the coming months will definitely have an impact in the market and for developers that would mean to continue experimenting with different aspects of the hardware and software until an immersive and enjoyable experience is created. I definitely will continue to expand my understanding in the field of Haptics.

References and Thanks

I would like to thank Professor Mitchell Theys for allowing the group autonomy when working on this project and suggestions for the approach we should use when initially starting the project. In addition it was thanks to U.I.C.'s Office of Facility and Space Planning's 3-D mass models that we were able to get the scale of the campus very accurate. Textures for the buildings and the information of the buildings themselves where used by Google Maps as well as pictures taken by group member Laurentiu (and organized accordingly by Jacob). Unity's massive asset store and availability of unique plugins simplified much of the scripting and made it possible to complete the project in a more structured way.