The Park; A Playful Educational Simulation of Managing Energy Supply with Finite Resources

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I. ABSTRACT

We have reached a point in history where there is a prevalence of new digital tools, but still experience influence from antiquated practices. Education is a subject that has greatly benefitted from new technology, but there are still many old methods that can be improved, replaced, or aided through digital means. Complicated topics that require visualization and system exploration can be better explained through computer intervention than in the traditional method of textbooks and lectures. With this thesis project, I sought to create a digital artifact that can aid the understanding of a specific topic that has proved difficult to teach otherwise.

II. INTRODUCTION

Background

My goal for this project was to create an interactive visualization presented using computer animation that allowed the interactor to make decisions that cause meaningful changes to the scenario. For this particular project, I focused on teaching the impacts of energy and environmental choices – both elements of a highly complex system that is difficult to visualize. These complicated systems are often not well understood by the average person, despite their importance of the variety of consequences that result from decisions regarding the environment. While this information can technically be relayed through traditional methods, such as text and lectures, understanding this system can be aided through digital means, such as interactive narratives and procedural models. What environmental and energy researchers really need is for the average person to be able to quickly and easily understand the impact of their actions. Most people will not voluntarily dig through troves of research in order to understand the complexity of this system. Thus, the objective of this thesis project was to create an educational artifact that aids both researchers and people unfamiliar with the topic of renewable energy and environmental resources.

Interactive Narrative Explanation

An interactive narrative is a form of storytelling in which the interactor can influence the events of the story with meaningful actions. The spatial, encyclopedic, procedural, and participatory affordances of digital media provide a richer experience than traditional forms of media and enhance the presentation of the narrative. Typically experienced through the use of a computer, interactive narratives can take many forms, such as being text-based or reliant on visuals. I believe that interactive narratives have a great deal of potential educational value, especially when mixed with three-dimensional visuals. 3D computer animation can be beneficial in allowing the interactor to better visualize concepts that have proved difficult to comprehend through traditional 2D formats.

Solution

In response to the problem area I identified at the start of this project, I utilized the Unity game engine to create a video game called “The Park”. “The Park” sets up a small interactive scenario for the player to wander through a virtual park that is affected by a variety of circumstances. Each day, the player is allowed the opportunity to make new choices about circumstances that affect the park, and can then see the effects that decision had on the appearance of the space. In addition, the park is inhabited by several people the player can “speak” with. Each of these park guests have specific interests in the park’s state, and will react to changes made by the player as he or she progresses through the story.

The goal of the interactor is to ride the grand ferris wheel that sits at the far edge of the park. This objective can only be reached, though, by finding the best balance between pollution and energy usage for the environment. This state encourages the player to consider the tradeoffs of different energy sources, such as cost, efficiency, and amount of pollution. There are also a variety of other choices that do not affect the ending of the game, but do alter the appearance of the environment.

III. CURRENT WORK IN THE FIELD

Inspiration

The idea for this thesis was inspired by a project I worked on in 2009, when I was a high school student. My chemistry teacher at the time demonstrated different molecular structures of the valence shell electron repulsion (VSEPR) theory by using construction and assembly toys; specifically, K'NEX rods and connectors. She would put the K'NEX rods together in the shape of each structure and hold them up for the class. This let us see a three-dimensional representation of the molecule that our textbook could not show us. Although the demonstration was effective, my classmates and I later had difficulty remembering the molecular shapes when studying for the test, especially as the note cards we were studying from could only show us a two-dimensional image. In addition, our textbook represented molecular structures as lines and dots, which could become confusing to interpret. Despite these difficulties, it was important to understand VSEPR theory because it tied together the other concepts of molecular chemistry we were learning about in class. I came up with the idea to make an animation that showed the VSEPR molecules as three-dimensional (3D) structures. With 3D animation, once you create a model, you do not have to redraw each frame as in traditional, hand-drawn animation. I felt that animation would not only help me and my classmates understand the structures, but it would also do justice to the lesson our teacher was trying to convey. It could also be used by countless numbers of other students in the future.

After creating the animation and posting the video online, I received an unexpectedly large positive response from the online community. Since then, I also created a few more simple animated videos explaining concepts from Calculus and Biology and posted those online as well. These videos diverge from the traditional style of lecturing, which, while clearly effective, is not always the most practical method for teaching certain concepts.

The purpose of offering this story is to provide a clear example of how effective digital artifacts can be as educational aids. While I did not create something extraordinarily revolutionary, nor overhaul the high school chemistry class curriculum with my simple animation, I was able to address this issue through digital visualization. The video was easy for anyone to watch, making it accessible to the general public. In addition, it could show certain critical features, such as 3D form, in a way that lectures and the flat pages of textbooks could not accomplish. This interest in exploring novel education formats and my passion for 3D animation and game design resulted in my desire to create a new interactive educational experience for my thesis project.

When I began this project in 2014, I was encouraged to consider other work that has been done in this field. This proposal to create a new kind of teaching tool is not the first of its kind. Nor is the idea to create an interactive simulation to teach about renewable energy. There have been a variety of attempts to create educational tools to teach this topic; I was mostly interested in designing a tool that would be based off of what I

learned through my earlier experiences making educational animations. But it is crucial to take into account and critique attempts other groups have made to present this material.

Earth, A Primer

“Earth, A Primer” is described as a “science book for playful people”. Out of the other projects that I looked at for this thesis, this specific project relates the most to the concept of reimagined educational practices, while also incorporating the topic of environmental systems. Earth, A Primer, is presented as an interactive book to help teach earth science. This particular artifact clearly draws on the typical format and material found in school textbooks in order to create a familiar experience. Each section is comprised of several “pages” that the interactor “turns” through to view. On almost every page, there is a short paragraph of text explaining that topic, and a 3D visualization that the viewer can interact with. Each of these visualizations is essentially a procedural model; a 3D model that follows a set of rules. In this artifact, these models typically consist of miniscule landscapes, governed by rules that relate to how the world actually works. For example, if the topic

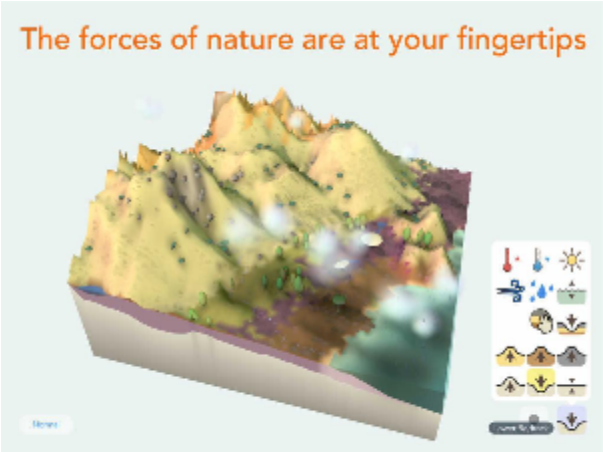

Fig. 1: Screenshot from Earth, A Primer

covers the effects of rain runoff on mountain ranges, the visualization consists of a 3D mountain that the interactor can run their finger over in order to deposit rain in specific areas. What makes “Earth, A Primer” a viable example of how digital tools can aid traditional forms of education is that it enables interactors to experiment with the earth science concepts that are introduced. While traditional textbooks rely on stagnant images and arrows to suggest change between stages of topics related to earth science, this artifact utilizes animation to show these concepts. Interactors can play with the models, ask: “what if?”, and try out different scenarios using the tools afforded by the app. The underlying procedural model in “Earth, A Primer” allows them to test out situations with mountains and rivers that are virtually impossible to achieve in the real world. It was this element of encouraging exploration that I found to be most interesting about this artifact. While designing my project, I kept in mind the methods used in “Earth, A Primer” to help interactors visualize complex, interrelated systems with a game-like structure.

Design a Renewable Future

Meant to emphasize the necessity of employing multiple energy sources, this tool encourages the interactor to design a system of sufficient energy production to reduce carbon dioxide emissions. Factors such as budget, variation in daily conditions, and changing community energy requirements make the simulation more challenging and realistic. These factors also help to potentially spur replayability. The interactor steps

through the scenario in a series of screens that allow them to choose a location to design for, then design a system by moving sliders. These sliders correlate to values such as the number of wind turbines, geothermal power capacity, and efficiency of solar panels. They are then presented with a bar graph that exhibits the effectiveness of their system. While this simulation is probably based on realistic values and pragmatic details, it is not necessarily fun to use or truly of value to the everyday person. The exact numbers and bar charts provided have little meaning to the interactor, and dehumanized the experience. It is also worthwhile to note that presenting the simulation across several separate screens disconnects the interactor from the data, and robs them of the ability to compare their results from each city or system they work on.

Fig. 2: Sliders used for system design in "Design a Renewable Future"

ElectroCity

"ElectroCity" leverages a fun, game-like structure in order to help develop public awareness of topics of renewable energy resources and

Fig. 3: Screenshot of ElectroCity.

electricity generation. Unlike the “Design a Renewable Future” tool, this artifact is engaging and enjoyable to play. The interactor can see visual representations of power plants and city structures they have built, can choose from a variety of options to further develop the land. Where it does fail is in showing the various effects of environmental decisions in a memorable way. The major effects of decisions made in the game - budget, energy supply, and environmental health – are represented with numbers and sliders. The game lacks any display of actual effects these decisions have on people and the environment.

Oil God

“The Arcade Wire: Oil God” is a video game that seeks to “explore the relationship between gas prices, geopolitics, and oil profits”. This project relies on real-world features and issues to convey the presence of a system with a multitude of variables, which in turn contribute to changes in oil prices. In this game, the player is an “Oil God” who has omnipotent knowledge and control over nine nations, and must double the cost of gasoline through a series of events such as wars and natural disasters in order to win. This game has a very satirical

Fig. 4: Screengrab from “The Arcade Wire: Oil God”.

interpretation of a political scenario, which emphasizes the opportunity for narrative within a digital simulation. This game is related to this project because it uses a game-like approach to make sense of the large amount of data that represents a system.

Windfall

The purpose of “Windfall” is to build wind turbines in specific locations around a town in order to fulfill a specified energy requirement. Although this game is more fictive than some of the existing projects reviewed earlier, it still manages to convey an important message regarding environmentally friendly energy production. If anything, its existence helps generate awareness of wind-generated power and the possible concerns associated with the technology. What I found particularly interesting about this game was that it focused on a small, specific topic, with limited gameplay decisions. Like many of the other projects reviewed so far, the results and consequences of the interactor’s actions in the game are displayed as numbers and sliders.

Fig. 5: The menu system in “Windfall” had a major impact on this project

Slavery Footprint

This project consists of an interactive website that walks the interactor through a short, unconventional survey to determine “how many slaves work on your behalf”. While this project differs from the others reviewed in that it is not necessarily game-like nor specifically related to environmental aspects, I chose to include it because of its ability to dramatize the human cost of a particular topic. In addition, it is presented in a way that makes it simple to use; site visitors simply click and scroll through the website as prompted. This increases the potential viewership of the project, as the website does not require special software to run since the whole interaction takes place right on the webpage.

Fig. 5: “Slavery Footprint” expresses the human cost of its topic

Comparison of Existing Work

After reviewing related works, I developed a comparison chart, to better illustrate the various elements of these existing projects. I have chosen specific aspects from these projects that I felt would most important to include in one single project. These elements were:

(A): Game-like structure.

(B): Incorporation of real world “data”.

(C): Environment/Energy related.

(D): Dramatization of the human cost.

(E): Use of a specific, focused topic.

(F): Visualization of a complex system.

	A	B	C	D	E	F
Earth, A Primer	X	X	X			X
Design a Renewable Future		X	X			X
Electrocity	X		X			X
Oil God	X	X	X	X	X	
Windfall	X		X	X	X	
Slavery Footprint		X		X	X	

Fig. 6: A comparison chart of the pre-existing work and their elements

IV. APPROACH

Planning

Once I had determined the topic I wanted to cover for this project, and had analyzed other works, I needed to plan out what I would actually develop for my game. Based on my research, it was clear that my best approach to making a scenario that stressed the impact of environmental decisions would be to create a game that allowed the player to move through a virtual space. By allowing the player to explore the impact of their choices in an enclosed environment, I could focus on dramatizing the human impact - a topic that was often missed in the “top down” views of other projects I had looked at. This encouraged me to consider creating a first person video game.

The planning phase was much more arduous than I had initially expected, since there are so many options for how the game’s central story and theme could be implemented. It was clear that the complexity of energy usage and pollution was more than just an issue that affected air quality and a budget; this is a topic that impacts politics, health, society, etc. It was critical that I focused on a segment of this complicated system, or risk the project getting too large. After considering many alternative options, I settled on setting the game in the environment of a park. Parks sit at the intersection of human life and nature, and as such, can act as a barometer of the health of this relationship. With this familiar, enclosed concept, I could focus on the issues of pollution and energy usage that I wished to present to the interactor, without losing the project’s scope.

Once the setting of the video game was settled, I began developing the story of the interaction. I considered common features of parks, and how they could serve as storytelling elements for the experience. Iconic features such as gazebos and ferris wheels could act as powerful points of interest for the player, and encourage them to explore different sections of the park. Natural settings like trees and ponds could help reflect the impact on the well-being of the environment. And the presence and state of recurring characters in the park could serve as a vehicle for relaying the human impact of the changes made to the environment.

Additional elements I had to consider involved the development of the scenario as something that would need to be explored by the user, so they could truly understand the complexity of the system. As evident in the current state of the world, there are trade-offs that cause “perfect choices” to be difficult or unattainable. For this game, players would need some incentive to sometimes pick bad choices, and learn that there are factors that block the ability to reach the perfect resolution to the situation. In order to motivate the user to work through these different options, I developed a list of issues that had some kind of conflict with each other. For example, waste management services, water treatment options, and power stations all cost money to operate, and the cost of these services is dependent on their form and size. So I included a budget that would force the interactor to consider where it would be best to spend their money.

The decisions the player makes about how they make use of the money they are given directly impacts the environment of the park. Poor waste management results in the appearance of litter throughout the park. But if the player allocates more of their money towards this topic, they are rewarded with a cleaner park. Similarly, the extent to which the water supply is cared for affects the appearance of the local pond, and the creatures who inhabit it. The more complicated decisions regarding the source of the area's power supply affects the air quality of the space, which then has an impact on the health of park guests. But these decisions are hampered by issues regarding the cost and efficiency of power supply sources, a feature that is inspired by real world details.

V. DESIGNING THE PROJECT

Overview

Once the planning process was complete, the development of this project involved four major stages: concept art, modeling/texturing/animation of models in Maya, Unity scripting, and user testing.

Concept Art

I sketched maps for the layout of the park, and considered the points of interest that may be necessary to encourage a player to explore a three dimensional space. An interactor's understanding of the story is directly influenced by the order in which they step through the plot points, so it was crucial to set up the park to direct the player through it correctly. It was through this step, that I figured that I could use features that act as barriers in the real world, such as bodies of water and bridges, to quietly enforce proper ordering of events in the three-dimensional space of the game. It was also in this process that I decided to implement a side panel. The side panel is meant to allow the player to make clear choices, since the purpose of this educational interaction is to show the effects of those

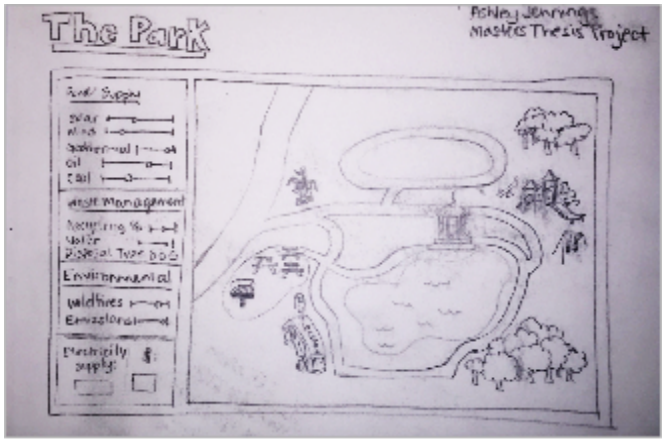

Fig. 7: An early sketch of the possible layout of the park.

choices on a complex system. In this way, the player could alter their decisions through the panel, then immediately experience the resulting consequences in the 3D park.

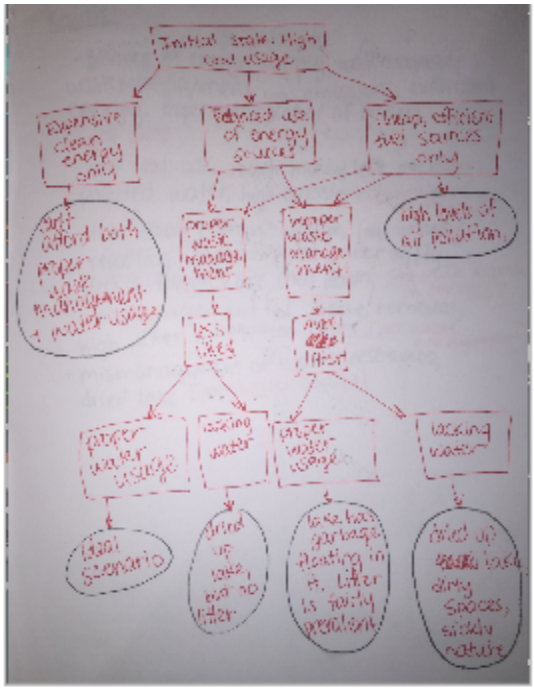

Fig. 8: Making decisions about story elements on paper

The concept phase also involves the creation of the story. I needed to plan out what actions the player could make, and what the results could be. In order for this to be a more powerful piece, I wanted certain combinations of choices to result in a variety of results. The procedural nature of computation media is one of the reasons why this educational piece can be made so much more effective through this format, as it is difficult to reproduce all these different scenarios without this technology. These decisions were also made on paper, before eventually being implemented in the script of the game itself.

Autodesk Maya

Once I had determined the main concepts that were involved in this game, I was able to begin creating the resources that would populate the park's environment. Before delving into this topic, it is worth noting that, at the encouragement of my advisor, I did make

use of many free assets provided online. This decision stemmed from the fact that this thesis project is meant to involve the creation of a digital artifact that can educate a user about a complex scenario, not to showcase my modeling and animation skills. So while many of the models were created by me, several have been generously provided through the Unity Asset Store by other artists.

The majority of the models I did make were those that I wanted to have a particular look, or could not find a comparable version of online. So I utilized polygonal modeling to develop the meshes for park benches, an ice cream truck, a swing-set, a gazebo, swans, windmills, solar panels, a gate, and a ferris wheel. These models were then textured using Autodesk Maya's UV texturing tools using textures I had either created, or found as free-to-use images online. Some models - such as the windmills, dog, gate, and ferris wheel - needed to be animated before being imported into Unity. This was also done in Autodesk Maya before they were later incorporated into the project.

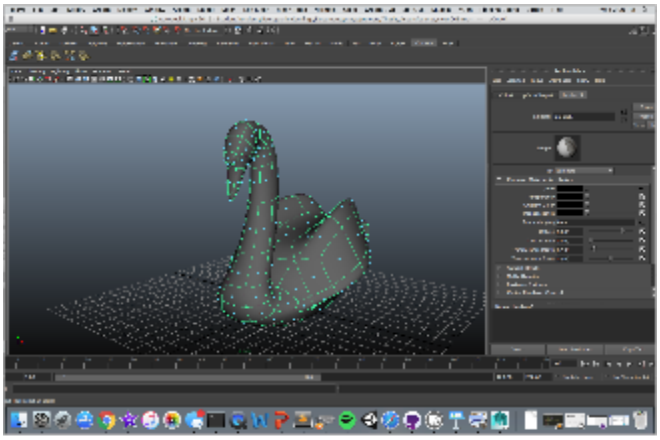

Fig. 9: A swan being modeled in Autodesk Maya

Once these models were prepared, they were able to be imported and used in Unity.

Unity

Working in Unity required an understanding of video game design, scripting, and working in a digital 3D space. I began the project by setting up a character controller provided as a standard asset through the Unity Asset Store, and creating a basic park layout. This involved changing the landscape of a plane so it would fit the plan I had for the design of the park space. I also found image assets that could be used as the landscape texture (grass and mud, for example), and found an asset for creating trees throughout the park.

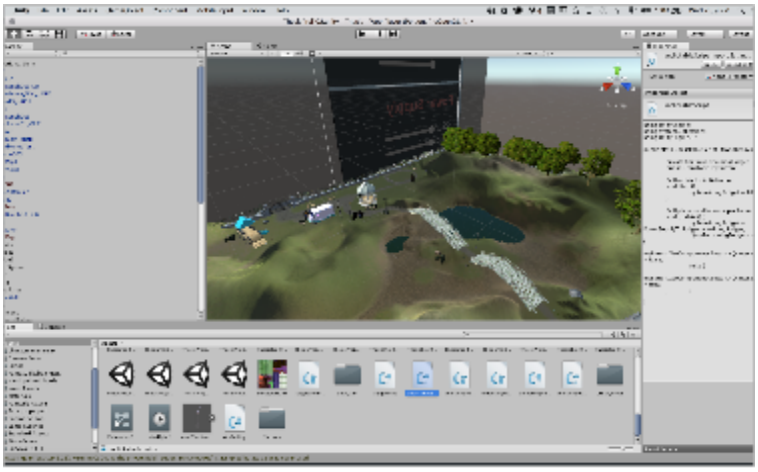

Fig. 10: Development in Unity required working with 3D elements and code

Once the basic layout was completed, work began on the panel. This element was integral to connecting the player's actions to the environment, and underwent many changes as development on the game progressed. The basic idea was to have separate sections of the panel, such as "Waste Management", "Water Usage", and "Power Supply" that the player could interact with and alter throughout gameplay. Sliders were implemented as the major UX element in this section of the game, and certain points along the sliders were set to trigger changes to the environment and other

sections of the side panel. For example, lowering the amount of coal being used in local power plants brought money back into the player's budget, and would clear air pollution, but drastically reduce the power supply in the area. Or changing the level of waste management being enforced in the park would reduce the visible litter in the park, but cause the player to lose money.

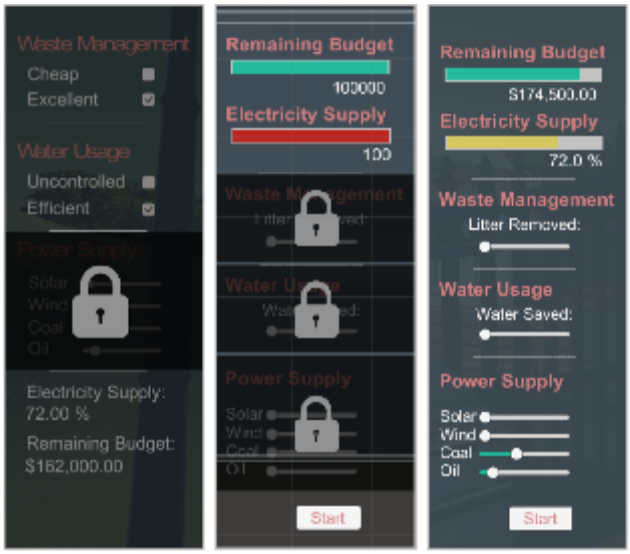

Fig. 11: Versions of The Park's side panel throughout development

Later in development, I added the functionality for panels to be locked during the player's first walkthrough of the park. These panels would then get unlocked as the player made beneficial choices in the game and progressed through several different "days" in the game world. Each new "day" in the game, the player could then focus on a different aspect of the park's environmental health.

Since one of the elements I identified as being crucial to creating a powerful interactive narrative was the human impact, I began work on added non-player characters (NPCs) to the game early on. These characters' models were from the Unity Asset Store, and I only had to make slight alterations to the characters' textures in order to incorporate them into The Park. I then added collision areas around each character that would

trigger text to appear on the screen when the player walked up an NPC. The text spoken by each character is completely dependent on the current state of the park. While each character focuses on a specific topic (some are upset by air quality, while others have interest in the park's pond), they also respond to the latest changes the player has made. This was done by creating a script that would watch for changes to the panel elements, and then update the text spoken by each character accordingly.

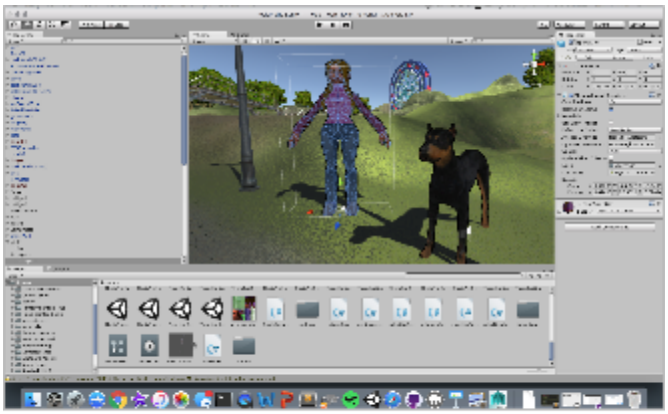

Fig. 12: Later in development, characters were added to the game.

A great deal of script was written to alter the appearance of the park. Everything from the color of the sky, whether or not the ferris wheel is turning, the height of the water level, etc is controlled through several dozen scripts I wrote.

User Testing

Playtesting of The Park began in late February. It was through playtest sessions that I was able to learn how the interaction worked and ensure that users were able to understand how the game worked. One of my main goals was to see players get

through the game without any outside help. The game needed to be easy to understand, so it could serve as the educational experience I meant for it to be.

I chose people who had a variety of backgrounds to playtest the game. Some people were familiar with playing games, while others were not. During the sessions, I asked each playtester to “speak aloud” as they played through the game, and then asked them a structured set of questions afterwards, regarding their experience and what they took from it. Many features that appear in the final artifact came about from feedback received from the playtest sessions.

Many people had a chance to test out my game as I was working on it, and there were six people that I was able to schedule a real playtest session with. Three playtesters were male, and the other three were female. Four of these individuals were in their early twenties, and the remaining were over fifty years old. And two of these playtesters were described themselves as being “gamers”, meaning that they were very familiar with the concepts and controls that are often used in games, including The Park.

I determined the issues in my game that needed to be addressed by looking for places where playtesters became confused or frustrated, and watched carefully for repeated feedback between users. Some of the earliest responses I received involved confusion over what the NPCs in the game were saying. Initially, each character only said their first statement once per day. So if they said something important and the player missed

it, the playtester could not go back and see what the NPC had said without starting the day over. I resolved this issue by allowing the interactor to choose when they wanted to hear what an NPC had to say by pressing the ‘t’ key to speak with that character. I also was encouraged to broaden the variety of phrases spoken by each character after user testing. My original plan was to have each character speak the same few lines every day, and to only change their speech when triggered by one specific change in the environment. Every one of my playtesters expressed frustration when being told the same things by the same characters multiple times throughout the game. The decision to vastly expand the characters’ vocabulary made the experience much more rewarding.

Another feature of the game that evolved from playtesting was the ability to pause the game and alter the choices during a day. I had initially planned to only allow the player to make changes to the environment before the start of each day in the game, a decision that seemed more realistic to me. Unfortunately, it became clear after many playtest sessions that the user quickly became frustrated whenever they realized that the exploration they had made with the sliders after each round would require them to walk all the way through the park in order to restart the scenario, just so they could change the sliders back again. The latest version of the game allows the player to press ‘p’ to pause the game, so they can make changes on the go.

During user testing, it became clear which elements of the game were really working. I noticed that all playtesters understood immediately that their goal was to figure out how to get the ferris wheel working, and that they needed to clean up the park in order to reach that goal. All playtesters were excited to see their actions cause a panel to unlock, and expressed happiness upon seeing changes in the park's environment, such as a blue sky, or the appearance of swans. Many players would exclaim: "I really like the swans!", or mention: "Wow, okay the sky is so blue.", when they noticed these changes. This positive feedback later encouraged me to add similar rewarding elements to the game, such as the appearance of wind turbines and solar panels when the player chose them as an energy source.

VI. IMPLEMENTATION

Software

As mentioned previously, I mainly used Autodesk Maya and the Unity game engine to develop this video game. The decision to use both of these tools resulted from my familiarity with each one, and they both allowed for the ability to have a lot of control over the resulting work. I wrote the scripts for Unity in C#, using MonoDevelop, which is Unity's standard IDE. The majority of the assets utilized in this project that I did not create were found through Unity's Asset Store.

Game Walkthrough

For the purpose of this paper, I will give a brief textual walkthrough of The Park. The experience begins with the image of the park's gate swinging open in front of the player. Initially, the player has no control over the side panel, since it is greyed out and locked. The interactor is encouraged to explore the park at their own pace, and they can quickly determine from looking about the environment and speaking with the other park visitors that the area is polluted and in need of help. The ground is covered in litter, the sky is filled with a hazy smog, and pond has dried up. The player is drawn to visit

Fig. 13: The appearance of the park at the start of the game.

the largest point of interest in the park, the ferris wheel, but the operator turns them away, explaining that the state of the park is too poor for the ferris wheel to be turned on and ridden.

When speaking with the ferris wheel operator, the player is given the option to return to the park on a “New Day”. The screen fades to black, and the player returns to the outside of the park’s gate, on what is meant to be a new day. After the first restart, the section of the panel that controls the “Waste Management” slider unlocks, and the player has the option to change the level of waste management being enforced in the park. As the amount indicated by the slider increases, the “Remaining Budget” bar at the top of the panel decreases. It becomes apparent to the player that the budget bar is affected by all the choices that will later become available on the panel.

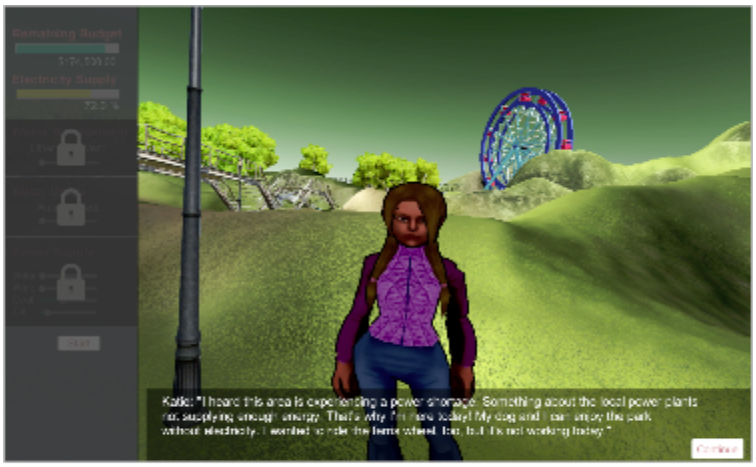

Fig. 14: An NPC mentions the rumor she’s heard about the power shortage in the area.

Once the player has finished making changes to the “Waste Management Slider”, they can continue through the next day by pressing the “Start” button on the panel. At this point, they can walk through the park again, but this time with less litter (this is truly

dependent on whether or not the player actually chose to eliminate litter from the park, of course). Each of the characters the player interacts with on their walk will comment on the cleaner status of the park, reinforcing the player's beneficial decision. When the player reaches the ferris wheel operator again, she points out that although the area looks much better, the park's management is too concerned with the contaminated, dried up pond to worry about turning on the ferris wheel. It is at this point that the player can again choose to start the day over.

On the start of the next day, if the player had chosen to resolve the issues with the litter before restarting the scenario, the "Water Usage" section of the panel will unlock. In the likely event that the player chooses to allocate a larger portion of the budget to fixing the water problem, the park will yet again change in appearance. If the water usage in the park is managed better, the large pond will fill up with water, and become populated with a family of swans. And like before, the NPCs in the park will comment on the change to their environment, and how happy they are to see the swans return to the pond. When the player reaches the ferris wheel operator this time, they will once again be asked to come back another day, because of the hazardous air

Fig. 15: Swans return to the pond after the player makes changes to the water management in the park.

pollution that still plagues the park.

The next day can act as the final day of the simulation, if the player manages to get the choices presented to them balanced correctly. For this time, the section that allows the player to change the source of the park's power supply becomes unlocked. There are four panels here, each of which affect the amount of solar, wind, coal, and oil being used for local electricity production. High use of more efficient and cheap options, such as coal and oil, can result in polluted air. But on the other hand, solar and wind power are too expensive to be used to fully supply all the necessary energy for the park's ferris wheel to run. But if the player does find a balance between all these options in the panel, they will be rewarded with a blue sky, and the chance to finally ride the ferris wheel.

Fig. 16: The appearance of the park after the player makes positive decisions.

VII. FUTURE WORK

Possible Extensions

If I were to continue to work on this project, I do have a list of features I would like to incorporate into the game. Since the goal of the project was to create an educational simulation, I would have liked to see more academic material in the game. An interactor could potentially learn more about the scenario I am trying to present if there were elements like tooltips in the panel, which would help describe the different energy options; or possibly a short debrief exercise at the end of the scenario, to assess the player's learning. Some of my playtesters even mentioned that they would be curious to know more about the efficiency of each of the different power supply formats. While the data I pulled off of government websites about this topic is encoded in my scripts, it is not easy to discern by playing the game itself. Instead, the player ends up getting more of a general idea about the difference in cost and efficiency of the different sources of electricity. Despite this, I decided to leave these ideas out of the final artifact though, because they would have required a great deal of more deliberate research about the topic, and appeared to be outside the scope of what I had chosen to create.

In addition to the inclusion of more educative materials in the game, if I had time to continue to develop this project, I would remove models I had collected from Unity's free resources and replace them with my own. The decision to use pre-made models and textures for some of the assets in my game allowed me to focus more on the experience I was working hard to develop. This way, I could spend more time on

polishing the interaction, which I found to be more relevant to the purpose of this thesis project.

VIII. Conclusions

Results

With the many digital tools that are available to us in today's world, it is important that we explore the positive impact technology can have on all aspects of our lives. Traditional methods of education have proved useful for many centuries, but we can now improve our understanding and conveyance of complicated topics through digital forms. We can easily provide more powerful learning experiences by taking advantage of the spatial, encyclopedic, procedural, and participatory affordances of digital media, and create fascinating simulations with these tools.

The final state of this digital artifact meets many of the expectations I had going into the project, and I am very proud of the end product. I learned through this experience about how crucial it is to playtest a digital artifact, as many of the best features in "The Park" resulted from a response to the issues that were discovered during user testing. I hope to continue to work on this project, as well as many other digital educational tools in the future, as they are clearly very valuable.

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