Team 08

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Final Project Report for Candle Simulator

I: Introduction

Candle Simulator was originally planned to be an experience created using Unity that was meant to highlight and replicate the complex and organic lighting, shadows, and movement of a candle in a 3D environment. It was an attempt for us to do our best to create a realistic candle and all the different diverse attributes a candle has. As the project grew, we expanded our ambitions and wanted to create a horror game out of it, with all the original features and ideas intact and built upon. Our product is meant to provide the user with an immersive and creepy experience by using the properties of candlelight, shadows, and darkness. The result of our work is a very simple horror game with some unique features and intriguing visuals. The main conclusion we have come to after working on this project is that the realistic manipulation of lighting and shadows is a complex and intricate challenge.

II: Example

When starting the product, the user will be shown a main menu screen that gives you the options of starting the game and exiting the game. The background of the main menu screen shows the lit candle illuminating the room around it.

When the user clicks on the start button, the player-controlled character will spawn in front of the candle, in the same room shown in the main menu. The user can then move around using WASD keys and look around using the mouse.

If the user were to walk towards the candle and click E when near it, the player would equip the candle. The user could also decide to walk away from the candle, but it is the only light source in the game and without it, the user is most definitely going to get lost. After equipping the candle, the user is free to walk around and explore the entire environment which includes five different distinct rooms that are all designed in unique ways to emphasize the shadows and light emitted from the candle.

III: Process

Our general approach to developing Candle Simulator was to communicate often with each other and work on whatever we could, whenever we could. The first thing we implemented was a small room with a table and a very primitive version of a candle, just so we could have a feel for what the project would grow into. Next, we worked on basic controls for movement and looking around After that, the main focus was improving the look and design of the candle. This included not only the candle holder and the flame but the light and shadows produced by the candle, which took up the bulk of the time and effort on the project. After getting the candle to a state we were proud of, we worked on the explorable environment and equipping and unequipping the candle. After working on the environment, we further brainstormed and figured that our game needed a way to win it, so we added three gold coins around the map and if you collect them all, the game ends.

Our planned timeline of tasks ended up being slightly different than our actual timeline of tasks. Since we decided to expand upon our idea of a candle simulator and create a horror game out of it, our original list of tasks no longer encompassed everything we needed to get done and all the tasks needed to be moved up on the timeline to make room. The planned timeline of tasks included the following: research and selection of packages and tools, design and implementation of basic candle and flame, creation of realistic shadows and fire movement, implementation of interactivity with the candle, and final testing. All those tasks were completed, but we had to include additional tasks of expanding the explorable environment and creating an objective in the game before the final task of final testing.

IV: Detailed Results

Candle Simulator includes several different features. Some of the normal features include basic movement and look controls, a main menu where you can choose to start or exit the game, and a pause menu where you can choose to restart, quit the main menu, or exit the game. As well as in-game music and noise. The project's most important special feature is the candle itself. It is a detailed candle with a realistic-looking flame that responds to the movement of the playable character. For the light emitted by the candle, we attached a point light inside the flame of the candle. We modified the color, range, and intensity of the light emitted so it looked as realistic as possible and created a C# script that utilizes Perlin noise to adjust the position of the point light. Adjusting the position of the light using Perlin noise gave the light a natural moving and wavering effect that a real candle would have. It also makes the shadows produced by obstructing the light grow and shrink and slightly waver. We also implemented an additional script, using Perlin noise, to adjust the intensity and range of the candlelight, which added to the look and dynamic qualities of the light.

The candle flame itself is an animation that works by looping over 256 different still images of a candle flame that lie in a 16x16 grid on a single PNG. It is implemented in the project by using a shader that takes the PNG of the still images and creates a 3D animated object out of it. Using that PNG, we created two different PNG images using Photoshop with the candle flames tilted slightly to the left and slightly to the right. Then when the user moves around when holding the candle, we change the PNG the animation uses depending on the direction of movement. This gave the candle the effect of how a real candle would respond to movement if someone were holding it and walking around.

Another special feature of our project is the environment you are allowed to explore. It consists of five different areas that contain decorations that are intended to show off and highlight the light and shadows created by the candle. Hidden within the environment are three golden coins. Collecting these coins is the primary objective of the game, and they are placed in the environment in a way where you'd have to explore the entirety of the environment to finish the game.

In the directory for our project, the two primary files are Assets and Build. The rest of the files are used by Unity to build the project and are essentially not important when analyzing the project. The Asset file contains all of the assets we used for creating this project, this includes a file that contains everything that has to do with the candle, then files for materials, prefabs, scenes, scripts, and sounds. The scripts file contains all of our code which is structured the typical way a C# script in Unity is structured. Each script is a class that contains its own variables and functions. Most of the scripts have a Start function that is called immediately when the object that the script is attached to is rendered, as well as an Update function that is called every frame. The prefab and material files include many different free prefabs and materials that we utilized from the Unity asset store and implemented into our project.

Our project should run smoothly on most modern computers, it is not demanding graphically or performance-wise. All you would need in order to operate this project would be a screen, mouse, and keyboard.

V: Future Directions

One major feature that we planned on implementing, but ended up not, was having the candle flame respond to a wind source. The candle flame being an animation of many different still images of a candle was the most realistic implementation of a candle we could find. However, this gave us limitations on what we could actually do to manipulate the flame. In order to have the flame adjust to the character's movement, we created two additional versions of the original animation that leaned slightly to the left and right. However, in order to make the candle flame respond to a wind source, we'd have to make at least a dozen different versions of the animation and apply them to the candle depending on the direction of the wind and the direction the candle is facing, which proved to be beyond the scope of our project and our abilities.

Another feature we talked about implementing was being able to blow out and relight the candle. It would be easy to add a user input that turns on and off the candle flame, but adding the details and multiple scripts that would be used for things such as the smoke when the candle goes out or the animation of the candle relighting, and adding a new game object such as a lighter to relight the candle would take a significant amount of additional time that we did not have.

One major feature we would add next that was originally unplanned is an adversarial agent that would chase the player around and would cause the player to lose if caught by this agent. This is the one main thing that our little horror game is missing, and it would be the first thing we'd implement next.

An additional feature, which is rather minor, that we would like to add next is a settings menu. It wouldn't be too complex to implement and we want to allow the player to adjust aspects of the candle such as the color, intensity, and range of the light. This would essentially be a difficulty adjuster because if you turn the range and the intensity of the light all the way up, you'd be able to see everything clearly. There is also some ambient music and sound effects in the game that we would allow the user to adjust as needed.

There are a few different routes we could take in terms of expanded development in the future. One is to go all in on candle implementation and attempt to make it look even more realistic, with more responsive behaviors such as wind responsiveness, smoke, sparks, the wick burning lower over time, or even the wax melting. Another direction would be to expand on the idea of making it a horror game, adding the adversarial agent, or perhaps even multiple different types of agents with distinct behaviors. We could also add different maps to explore and even multiplayer compatibility. The more we discuss possible development paths, the more ideas we come up with.

VI: Conclusion

Our overarching goal for this project was to simply create a realistic candle and flame in Unity. However, after starting the project, we all came to the same conclusion this goal was anything but simple. There are multiple different complex aspects of lighting and shadows that need to all work together in order to make natural-looking candlelight. Through our combined efforts, we created a candle and flame that we are proud of, as well as a mini horror game and environment. Working on this project gave us all a better understanding of the dynamics of shadow and light in a virtual environment and the underlying programming and code it takes for producing such effects.

VII: Team Summary

Jacob Baber primarily worked on implementing the candle, its behavior, and some elements of the UI and environment.

Shiyuan Liu worked on basic functionalities and UI design.

Nathanael Reese worked on movement controls, equipping the candle, finding and fixing bugs,

and the environment.