**Disk Wars VR**

Capstone Project Post-Mortem

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\*Note that this version of the Disk Wars VR Post-Mortem document does not contain the author’s private team member evaluations. A version of the document with those evaluations included can be found under Matthew Spedale’s Post-Mortem document submission on Moodle.

Introduction

Disk Wars VR is a 3D virtual reality arena combat game based on the Disc Wars games seen in the “Tron” movie franchise. It is a competitive game in which two players - restricted to opposite sides of an arena - compete to hit each other by throwing disks within a confined environment, in which these disks will bounce around until they either hit an opponent, or the respective player catches it to throw it again.  The goal of the gameplay is for it to be fair, easy to learn, hard to master, and fun for players of all skill levels.

Disk Wars VR is developed for the PC platform using Unity 2017 as the game engine. It uses the HTC Vive virtual reality headset for the VR integration, as well as allowing for roomscale to track the player’s movements along with the Vive wand controllers for tracking the player’s hand movements. It features online multiplayer in order to facilitate the use of two virtual reality headsets in each match, since most headsets available on the market do not support local multiplayer due to the potential for injury.

Disk Wars VR is a team collaboration by Matthew Spedale, Patrick Richardson, Cameron Moore, Jonah Knickles, and Alaijah Moses, created for the EE 4859 class offered at Louisiana State University in the Spring 2018 semester.

Pre-Production

Origins of the Concept

For the capstone class, Patrick, Cameron, Jonah, and Matthew decided early on to work together on a project. The four of us knew each other from prior classes, and Cameron, Jonah, and Matthew had worked together on a 2D game for the Game Design class offered through the Computer Science department. We added Alaijah to our group after she offered to do the graphical work for the game, which was perfect since no one in our group had experience with asset creation.

We decided on the game concept that we wanted to create relatively quickly. The four original members of the group are all big Tron fans, and we wished to make a game that utilized virtual reality from the beginning of the class. One weekend, we got together at Patrick’s apartment to discuss game ideas for the project. That night, we wound up watching Tron Legacy just for fun. As the movie progressed, someone suggested that we adapt the Disc Wars game seen throughout the franchise into a VR game. Everyone was on board with the idea, and that was that. We decided it would be a natural fit for Disc Wars to adapt it to a VR game, and that it would totally fit with the aesthetics and themes of technology inherent to the Tron franchise.

Core Concept

As stated in the introduction, the core concept of Disk Wars VR describes it as a competitive 3D virtual reality arena combat game based on the Disc Wars games seen in the Tron franchise. During the pre-production phase, we outlined six core components of the game that we wanted to adhere to as our central design philosophy, in order to keep each member of the group on the same page and to guide us toward creating a unified and cohesive central product. These six core components are:

1. Duel Mode – 1v1 duels of skill. This would serve as the main multiplayer mode of the game, and where players would spend most of their time.
2. Practice Mode – hone your skills by yourself. This mode would allow players to practice alone before going online.
3. Virtual Reality – From the beginning of the project, we wanted to create a VR game even before we knew what we would make. This was essential to the Disk Wars VR experience.
4. Network multiplayer for online play – Also essential to the project, since most VR headset available today do not support local multiplayer between two headsets. This also posed a unique challenge, since no one in the group had experience programming for online multiplayer and networking.
5. Gameplay faithful to the Tron version – Though numerous video game adaptations of Disc Wars have been made for home video game consoles, none exist that take advantage of virtual reality as far as we saw. This allowed us the opportunity to use the technology to put a fresh twist on a familiar formula.
6. Soundtrack fitting to the Outrun style – Early on, we decided that we wanted to emulate the synthwave/outrun genre of music for the game. Though this was not a component of the Tron version, we thought it would add a unique flair to our game, as well as fitting Tron’s distinct retro-futuristic aesthetic. Synthwave and outrun are genres characterized by the heavy use of synthesizers, a focus on driving, repeated beats over clear melodies, and a resemblance to video game soundtracks of the 1980s. Influence from this genre was drawn from artists like Kavinsky, Justice, and Perturbator.

Software

Throughout the development process, our team utilized numerous software programs to create different aspects of Disk Wars VR. Below is a complete list of the software used in developing Disk Wars VR, and the functions of each:

1. Unity 2017 – Perhaps the single most essential program utilized by the team. Unity provided a game engine used to run the game, development tools to create it, and a VR framework for easily translating our game to virtual reality using the HTC Vive headset. All members of the team had prior experience in Unity from various projects, which is why we used Unity over another engine like Unreal. We utilized the 2017 version of Unity for our project, as it was the most up-to-date one available at the time.
2. Studio One 3 – Digital Audio Workstation (DAW) used for the creation of all the music and sounds heard in the game. Allows for creation, editing, mixing, and mastering, so all the audio work was done in this one software. Matthew Spedale, the music and sound designer, had extensive prior experience with this software and decided it was the best choice for him to work with.
3. Blender – 3D graphics toolset used for the creation of most of the models used in the game. Alaijah Moses, the team artist, had prior experience with the software and decided it was the best choice for her to work with,
4. Git – Version control system used for tracking changes to code over time and between members. This allowed the team to compartmentalize and work on each part of the project at once, without having to worry about overriding each other’s’ progress. Each member of the team had extensive prior experience using Git for version control.
5. Github – a web-based version of Git that essentially provides a more robust GUI for Git. We used the site concurrently with Git itself.
6. GIMP – Freeware image editing software similar to Adobe Photoshop. Used for asset, texture, and logo creation.
7. Trello – Project management website. Used by the team to manage roles, goals, progress, tasks, and to keep everyone on the team informed.
8. Visual Studio 2017 – Integrated Development Environment (IDE). Utilized by the team for the creation of code applied to the project. Each member of the team had extensive prior experience using VS2017 for code creation.
9. Notepad2 – Text editor used for code creation.
10. Monodevelop – Text editor used for code creation.
11. Google Drive – Cloud-based storage website. Primarily used for the team to share documentation.
12. Discord – Communications software. Allowed the team to make a private server that we could use to communicate with text and voice chat.

Development Process

During the pre-production phase, which lasted from roughly the beginning of the semester until February 28th, the team achieved a number of milestones leading up to development. The most basic was assembling the team; as stated previously, four members of the team had experience working together on projects before, and organically decided on working together again for the capstone class. We added Alaijah as a fifth member of the team when she indicated interest in our project and offering to be the team’s artist, which was a perfect fit since that was the one role none of us had the experience to fill.

The next important milestone was the formation of the project idea and fleshing it out. Through numerous team meetings that involved extensive research, we decided on the “Tron Disc Wars” concept to create for our game, and decided on VR integration because it was a natural fit for the style of the game and was what we were interested in. To this end, we created multiple documents to further flesh out our vision to ensure consistency between members during all stages of development. These documents were a “one pager” that served as a short elevator pitch of the game to entice players, a conceptual design document to outline the concept, a technical design document to outline the more minute aspects of the game, an art bible to showcase the art design and what influenced us, and a short vertical slice that showed off the throwing and catching mechanics in VR.

The third important milestone of pre-production was the vertical slice itself. As mentioned before, the vertical slice served as a nice proof-of-concept. Our vertical slice was an extremely basic version of the practice mode. It allowed a player to spawn in an arena by themselves, and using an HTC Vive headset and wand controllers, they could throw and catch the disk as they would in a real match. It included a basic version of the player model, the arena, the disk, appropriate sounds to go with it, and all of the mechanics of catching, throwing, and disk movement incorporated. This served as a perfect foundation for beginning the production phase, as it meant we could build off of the work we already had for the vertical slice.

What Worked?

First, our team dynamic worked pretty well from the start. Since most of us on the team already knew each other and had worked together on projects, we knew each other’s’ skill sets and what role each person was best suited for. This made splitting the work into separate roles very easy; we had one person who was best working on sound and music, and project management (Matthew). We had two others who were best at working on the game design and networking aspects (Cameron and Patrick). We had another who was best working on fleshing out the environment of the game and handing the UI (Jonah). Rounding out our skill set, we had an artist who could handle modeling and asset creation (Alaijah).

Second, our team had a very focused idea of the project itself early on. We talked extensively about what we wanted to work on, what type of game we wanted to make, and how we would go about doing it. Outlining the mechanics and style of the game got us all on the same page early on, and we were also quickly able to decide on software, development methodologies, and so on that made managing our work flow easier. Having all of those pre-production documents written helped the team as a reference throughout the entire development process, to aid each member and ensure that their work was parallel to what was needed for the project.

What Didn’t Work?

The main issue that arose during the pre-production process was the amount of time it took for the team to have access to the technology and software we needed. The laboratory in the Patrick F. Taylor building where our capstone class met did not have useable computers with the software we needed installed on it until nearly a month and a half into the semester. This meant that we lost a lot of time that could have been used for getting the game in development. During the period, the team was forced to largely work from home on their own devices. This was unfortunately an issue that relied on the building’s IT department to resolve, but it was still an unfortunate obstacle to the development process. In the future, hopefully the class can be managed so that the proper resources are available to students at the beginning of the semester.

Production

Game Engine

As stated previously, the team decided early on to develop Disk Wars VR using the Unity engine, more specifically the 2017 edition of the software. We decided on Unity as our game engine for numerous reasons. First, Unity allows their engine to be used for free by students and for projects estimated to be making less than $100,000 on sales. This was perfect for our team because we would not have to pay anything and still have access to fantastic software, while also having the option to buy a Unity license down the line if we ever decided to develop Disk Wars VR further into a fully-fledged game and sell it.

Second, all members of the team had used Unity for personal and class projects prior to the capstone course. That meant we were more familiar with the engine than we were with other options, like Unreal. This propagated faster, more reliable development and code generation.

Third, Unity offered extensive VR support for game development. Unity VR allows developers to target virtual reality devices directly from Unity, without any external plug-ins or projects. It also provides a base API and feature set with compatibility for multiple devices. This meant that were able to develop for the HTC Vive in a much simpler manner thanks to the tools provided by Unity.

Asset Creation

Due to the nature of Disk Wars VR, we had two major assets that required software other than Unity to create. These major assets were the models for the game, and the sounds. Unity does offer tools for developing models of basic geographic shapes, which we did utilize for populating the city environment that exists around the arena where players compete. This allowed us to create buildings, billboards, and cars to inhabit the city and make it appear alive and give players the sense that they are participating in a game that takes place in an actual, fleshed-out world.

For models that required more finesse to make, our team artist used Blender for asset creation. She chose Blender because of her previous experience using the software, as well as because Blender is free. This allowed her to create the player models for both characters competing against each other in Duel Mode, as well as a practice dummy to train with in Practice Mode, a disk model to throw and catch, and the arena environment that the game takes place inside of.

Our team sound and music designer used Studio One 3 to create the songs and the sound effects heard throughout Disk Wars VR. Like Unity and Blender, Studio One was chosen due to the team member’s previous experience using the software for creation. Early on in the pre-production process, the team decided on a synthwave/outrun genre style for our music to emulate and draw inspiration from. During the production process, we decided to not strictly stick with this style for VR Disk War’s music. For one, we realized that we wanted to be able to make the music more original and symphonic, rather than being pigeonholed to the aesthetic of the synthwave genre. Though some songs still emulated this genre (“Light Riders”), others (“Subversive”, “Disk Wars”) pulled slight inspiration while also expanding to different genres entirely. Overall, this allowed us to have a unique soundtrack with songs drawing from multiple genres while still feeling cohesive. In total, the game features four songs, which was an intentional choice on the team’s part. Matthew developed about six songs total for the game with several other unfinished demos as well. He worked that way because he decided it would be best to create more music than needed, then to let the team decide on what worked best for the game and include only that in the final product.

In addition to the music of Disk Wars VR, Studio One was also used to create the sound effects heard in the game. This involved working with the game designers to outline what actions needed sounds to correspond with them, and how they should sound. In total, over thirty sounds were created using Studio One’s vast array of pre-packaged instruments and mixing options to create unique sound effects.

Major Developments

Once the team reached the production phase, we already had a stable foundation for the game with the implementation of the throwing and catching mechanics. This meant that the production process mostly involved building off this prototype to continue development.

The first major development was getting the environments and models done and added to the game. For the prototype, we included a very basic disk model, player model, and a barebones arena and background environment to compete in. This worked for showing off the vertical slice, but we knew we would need more visual flair for the full product. During the semester, our artist used Blender to flesh out those pre-existing assets, as well as creating new ones. Meanwhile, Jonah worked on fulling the city environment that exists outside of the arena with numerous entities that make it seem more alive like a real city would be. This included billboards with advertisements, cars that drive around, and buildings that appear populated.

Our second major development was getting the soundtrack and sound effects developed and implemented. Our team sound designer spent most of the semester working on creating music and sounds for the game, as well as mixing, editing, and implementing them into the game itself. This involved numerous scripts that were programmed to work with other components of the game so that each action had a corresponding sound effect. Examples include sounds for when a match begins, when a disk hits a player, when a disk hits a wall, when a match is won or lost, and so on. The music was implemented into the game with a script that would check to see if a song was playing, and if not, randomly choose a song from the soundtrack to play. It was programmed such that it does not pick the same song twice, allowing for diversity in the music the player hears throughout the match.

The third major development was in the implementation of the networking and VR capability. The VR was relatively simple to implement thanks to the extensive tools offered by the Unity VR API, and mostly involved minor fixes and improvements from our programmers to make the catching and throwing work perfectly while using an HTC Vive. The networking proved more difficult to implement; none of us had experience in programming for multiplayer networking, so our team had to learn on the fly using Unity’s documentation. One nasty surprise was that networking is handled differently for VR than it is for non-VR games in Unity, which required a rework of the networking code at one point. This was probably the most time-consuming part of the project, as getting the networking code perfect was essential to an enjoyable experience since the majority of the game is in its multiplayer Duel Mode.

The fourth major development was in implementing the match logic. This involved having the proper win-loss states for each player, collusions with the players and the disks for when a player is hit, and timing of the matches. This also involved extensive playtesting by various members and a lot of alterations to the code to ensure everything felt right, fair, fun, and so that the match length was not too long or short.

Team Communication

Our team primarily used three tools to communicate over the course of the semester. These tools were Trello, Discord, and our cell phones. As project manager, Matthew created a Trello board and a Discord server for our teams to use. The Trello board was used to outline the goals of the projects, the tasks each member was currently working on and had to work on in the future, as well as to track the attendance of each out-of-class team meeting. The Discord server was used for the team to be able to easily communicate with one another outside of class using the group text chat, as well as the voice chat and screen sharing options that allowed us to work together effectively even if we weren’t in the same building. Each member of the team also had the others’ phone numbers, but we mostly used Discord for communication.

What Worked Well?

Overall, the team did a great job outlining the important work that needed to be completed during the development phase, and getting said work done. Throughout the course of the semester, we were able to get the netcode working properly, have the match logic so that every game of Disk Wars VR was fun and fair, create and implement sound effects and music that felt natural to the world of our game, and populate the environment of Disk Wars VR with a city that feels alive. Our team also kept in constant communication between using Discord, meeting in class, and having weekly meetings outside of class time to work together. This meant everyone was always on the same page as to what was being worked on in the project and what still needed to be done.

What Didn’t Work Well?

As mentioned previously, one aspect of the class that hindered production was the amount of time it took to get working computers that had the software the team needed. This took about a month and a half, which meant we lost a substantial amount of time that could have been used to develop all of the minor things that we cut from the game. Overall, we felt satisfied with the progress we had with Disk Wars VR by the time the project was due at the end of the semester, but we will continue to work on the game ourselves outside of the context of the class over the summer before we consider it to be complete and ready to release to the public.

Final Submission

What We Have

For the final submission of the capstone project due on May 2nd, Disk Wars VR is in a good place in terms of a minimum viable product, but still has additional development to complete outside of the scope of the class before the team would release it to the public. We would like to continue developing Disk Wars VR during the summer, and plan to hopefully release it for sale on the video game distribution service Steam sometime this year.

As for what our game currently has implemented, the team was able to meet all of the core components that we outlined at the beginning of the project. Both Duel Mode and Practice Mode are currently implemented and playable. Duel Mode has some refinements that will be necessary before full release, mostly in improving the VR and networking. The game has a full soundtrack with numerous songs for players to enjoy while competing, and a wide array of sound effects that indicate everything that happens in the game. We are satisfied with the graphics currently in the game, as we always wanted a low-poly retro-futuristic style that emulated the look of the first Tron movie and early 3D rendered games. Lastly, the VR works for players using the HTC Vive headset. As always though, it could use some improvements in making it a smooth experience.

What We Cut

For the most part, the things that we had to cut from Disk Wars VR were stretch goals that were always intended to only be added if time permitted. Some of the things we wanted to include in the game but didn’t have time to implement during the semester were multiple playable environments, multiple player models that the player could choose from to personalize their avatar, a loadout system that allowed players to use disks with different attributes that facilitated alternate playstyles, stage hazards for the player to avoid, and power-ups that would temporarily give the player additional capabilities to help them win. None of these elements currently exist in the current game, but could be implemented in the future as we continue to work on Disk Wars VR. As it stands, the core concept of Disk Wars VR exists fully realized in our final submission of the project for the end of the semester, while still existing with room for expansion and improvement in the future.