

Precision VR: The Ultimate Gun Range

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Our project is a VR Gun Range featuring multiple different scenes, modes, and features. It is made in a low poly, medieval style world. Taking inspiration from Dr. Cruz's work and other VR games that exist already, we aimed to make it a fun and interactive experience for the user. We accomplished this through the creation of three different timed game modes, as well as an untimed, casual mode. While we still have many things that we could further implement, we are happy with the progress that has been made, as we delivered on our original proposal.

Introduction & Motivation

Initially, our project aimed to create an engaging and interactive VR experience, starting with an entertaining gun range designed to improve reaction times. When we started, none of us had any proficiency in VR development or, more specifically, Unity development. This lack of experience meant we needed to select a project that, while ambitious, was also feasible for beginners. The gun range concept fits this description perfectly in our minds.

At first glance, the project seemed simple: create a 3D environment, a VR rig, and add gun mechanics. However, we quickly realized much more was involved in making the experience successful. Proper implementation of a gun range in VR required us to pay close attention to the user—their controls, their interaction with the environment, and their overall sensory perception within the range. Cutting corners on these elements would break immersion and create discomfort or harm for the user.

Beyond these technical considerations that would pose a challenge, we were also motivated by the project's potential as a learning platform for VR development. The simplicity of the gun range made it an ideal foundation to explore and implement fundamental VR mechanics, such as user input handling, environment design, and sensory feedback. By starting small and focusing on core features, we allowed ourselves to expand the project later. As we became more proficient, we outlined additional goals, including implementing features that could enhance the experience or even serve as the basis for more complex VR environments. This forward-thinking approach allowed us to view the gun range as an end goal and a stepping stone for mastering key VR development principles.

Another important goal of this project was to be adaptable, allowing us to incorporate concepts and skills we learned in class as the semester progressed. With

our project's flexible outline in place, we wanted to be able to integrate new techniques and approaches as our understanding grew. One example of this included our implementation of synesthesia midway through the project (This will be further elaborated upon later). This adaptability proved invaluable, enabling us to bridge the gap between theoretical knowledge and practical application. By aligning the project's development with our learning, we could ensure that each new concept we encountered in class could be applied directly into development if applicable, helping us solidify our understanding of VR development while enhancing the quality of the final experience for the user.

Background, Related Work, & Inspiration

Our project aligns with a few trends in the field of VR, particularly the push toward creating modular and immersive experiences that adapt to both user preferences and developer growth. As previously mentioned, rather than being a standalone game, our gun range was envisioned as a foundational experience that could expand into a broader platform for multiple VR scenarios. This approach reflects the increasing popularity of customizable and scalable VR environments, where players can explore various interconnected themes. We were inspired by Dr. Cruz's work on "Themed Experiences," in this regard, we focused on designing a 3D environment that would allow for the integration of new game modes or entirely separate experiences.

In addition to themed experiences, we drew inspiration from pre-existing VR titles such as **Superhot VR** and **Pistol Whip**. These games exemplify the potential of gun-based, fast-paced gameplay in dynamic environments, challenging players to think quickly and execute precise actions. Their innovative design served as a benchmark for our project, as we aimed to replicate some of the excitement and intensity of these experiences while adapting them to our unique vision.

We also took cues from the physical interactivity of games like **Beat Saber**, which would integrate movement into gameplay to create an experience that is both engaging and physically active. While we focused on firearms rather than rhythm mechanics, we sought to incorporate fluid, motion-driven elements that encouraged players to move within the environment. This added a layer of immersion and excitement, making our project a test of precision and reaction time and an active and engaging VR experience.



Pistol Whip on top left, Beat Saber bottom left, and Superhot VR on the right.

Conceptual Design and Technical Approach

Our project is intended to be a fun, interactive game about shooting targets with various guns. We specifically took a low-poly approach to prioritize minimal computing power needed over maximal realism. This also helped keep development time low when creating our scenes.

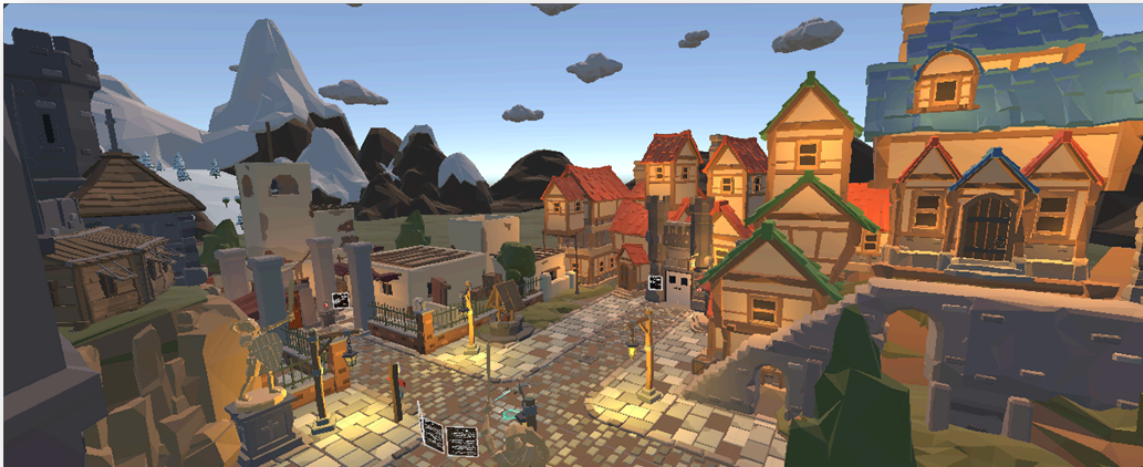
We wanted users to feel like they were in a medieval environment and a low-stress world. This is reflected through our use of targets only vs. any objects or characters that could cause the user stress (such as something running at you). We feel that this goal was achieved, as the worst thing that can happen is that you simply run out of time, nothing more.

Technically, we split up the work by area and by game mode. We did this for several reasons, such as not having interference within version control, having more ownership over your specific work, and being able to see an idea from start to finish, among others. This approach worked well for us, as each of us could focus more heavily on the things we did work on instead of spreading our focus out to several different tasks at once. This also meant that when completing activities such as bug fixing, each developer knew that the bug was likely to have originated in code they wrote and learned well, cutting down on debugging time.

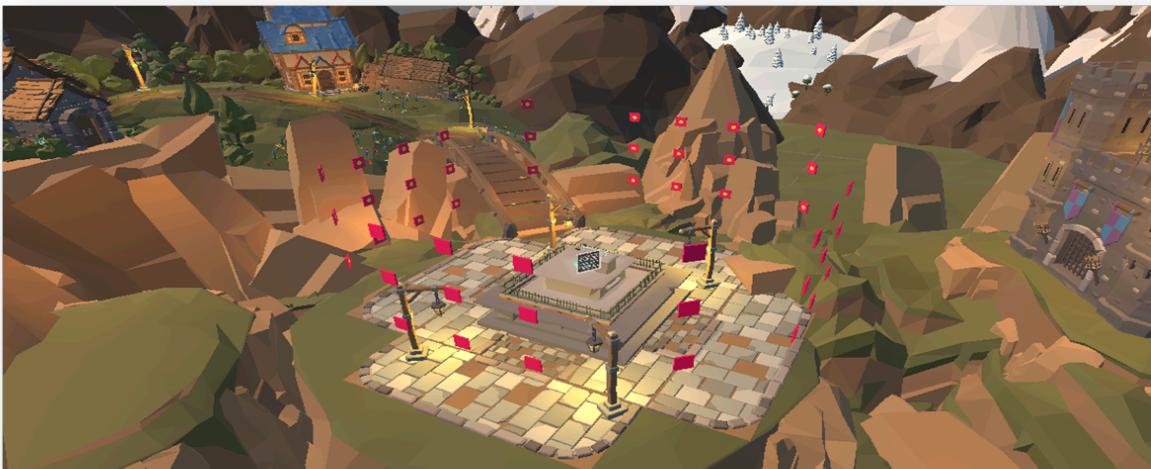
Results and Technical Details

A complete scenario of our project involves five elements: the hub world, the Tactical Destruction game mode, the Speed Test game mode, the Accuracy Test game mode, and the Free For All game mode. The user starts in the hub world, where they can read about the purpose of our project, learn the controls, and be directed to the two different gun ranges. This is done through three reader boards always present in the scene, so users can easily refer back to them whenever they are in the hub world. Below, each of our scenes/game modes are more thoroughly explained, and pictures are given below each paragraph to provide a feel for what it looks like.

From this hub world, you can enter two different gun ranges: one contains the Tactical Destruction game mode, while the other contains all other game modes. The two ranges serve two different purposes: one provides a 360-degree shooting range, where the user spins to reach all targets, while the other provides a classic gun range feel with targets downrange in a single direction.



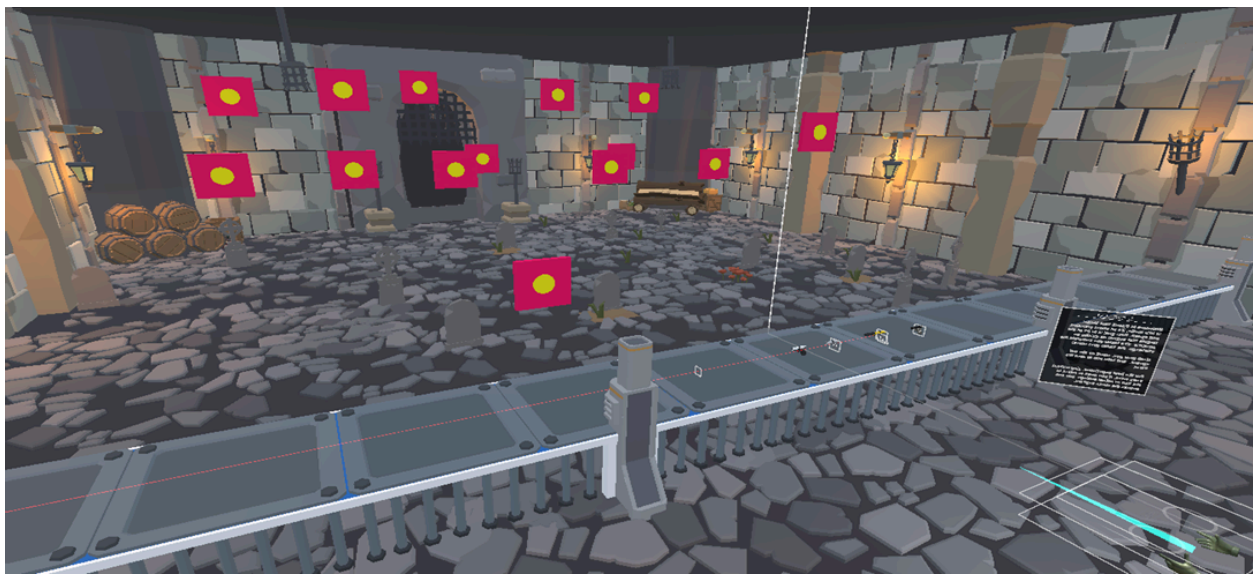
In the Tactical Destruction game mode, the user is transported to a 360-degree gun range, where targets spawn around them. Specifically, ten levels require the user to shoot a random set of targets within a specified time. If the user succeeds, they progress to the next level. However, if they fail at any level, they will lose the game entirely, being forced to restart from the first level of the game. If the user passes all ten levels, they can stop there or continue to an “endless” mode. Throughout the game mode, whether the first ten levels or the endless mode, the number of targets will slowly increase while the amount of time slowly decreases. When the user completes the Tactical Destruction game mode, they can return to the hub world.



As for the other shooting range, our project offers a much more well-known range style in which the user is only faced with one downrange option. Here, the user is

presented with multiple guns to use and two main types of targets to shoot: some that break upon shooting them and some that fall down when shooting them. The reason for having two kinds was that in some cases, it was better to have the target disappear wholly and quickly (Speed Test), while in other modes, the realism of a target falling or rising back up was prioritized (Accuracy Test). More details about this initial scene are detailed below in the Free For All section.

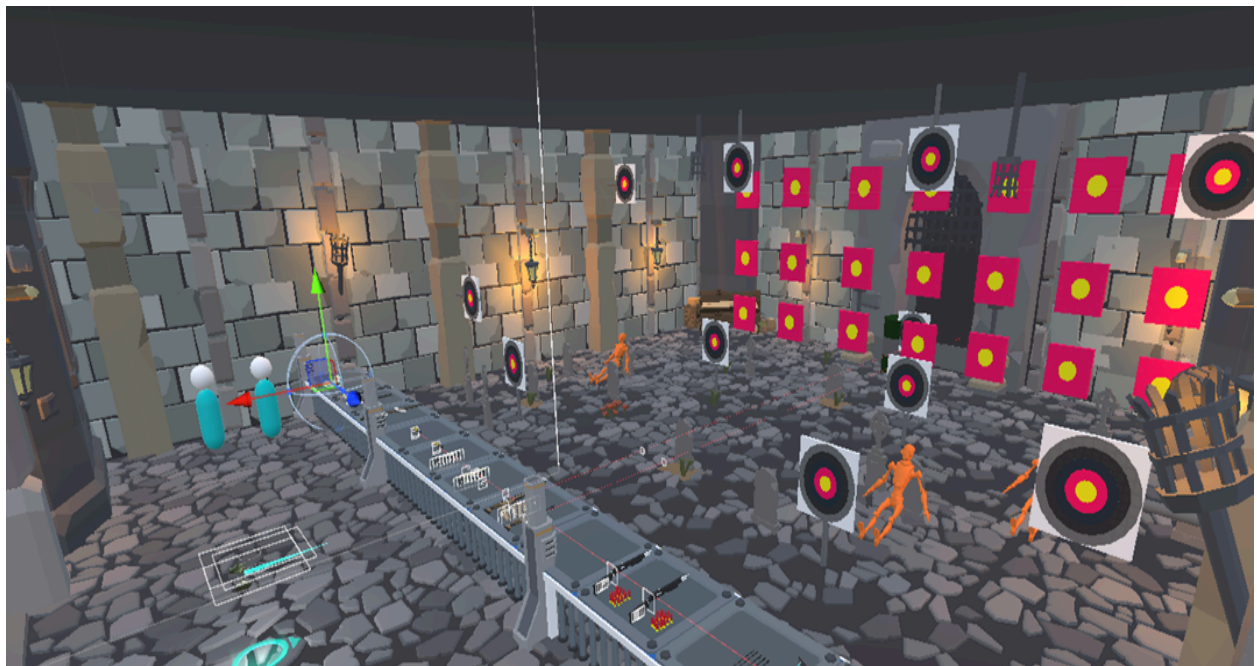
In the Speed Test, the user is greeted with a static set of targets. The goal is to shoot each target as fast as possible. As the location of the targets does not change from run to run, the user is able to hone a rhythm and attack vector to maximize efficiency and, therefore, get the best time possible.



In the Accuracy Test, the user faces a series of levels where targets move out across the floor to be shot by the user. The targets will fall naturally when the user shoots them and rise when prompted by the level's design. More importantly, these targets feature rings, each with a point value. These points are tallied up throughout the round, and if the user fails to attain the needed number of points in a round, the user fails the round and must start over again. If the user passes, they are moved to the next round, where the points reset, and an entirely new level begins. Throughout the levels, different aspects test the user's accuracy, such as moving and long-range targets. These aim to fully encompass the experience of shooting these weapons and being able to aim them properly.



In our Free For All game mode, the user is presented with a combination of the Speed and Accuracy Test targets. These targets are static, with set respawn times so the user never runs out of things to shoot. Additionally, some guns are set up to have infinite ammo, so the user does not have to reset the scene because they ran out. There are also added targets and features, such as a cannon that shoots a box into the air and an explosive barrel. There are also melee weapons and bows here, which our framework came with, so we wanted to acknowledge that capability at least.



Conclusions and Lessons Learned

One big lesson from this project was that we did not have to learn the hard way: using prebuilt frameworks and assets can be a huge help when developing a project of this scale. Our use of the VR Interaction Framework helped us immensely in development, whether in the sense of logic, implementation details, or simply time. We could seamlessly integrate our ideas and goals into this framework and achieve far more than we ever would have had we created all of this work ourselves.

As for what we did get done, we could have done more this semester had we put more time into it, but unfortunately, that was not the case. While we did deliver on our promised project, if we could have found more time, we could have completed some, if not most, of the work detailed below in the Future Work section.

That being said, we are still happy with what we were able to deliver. Our project is a completed and fully functional game with several different engaging modes and environments. Completing all of the different modes can take up to an hour, and even then, there is still fun to be had after doing so, such as the endless mode in Tactical Destruction. Additionally, with the addition of some of the ideas in the Future Work section below, we could expand this project to have hours more content for users.

Future Work

One big next step for the project would be to add another type of gun range (such as a kill house). The hub world is set up so that each of the four cardinal directions can be used as a portal to a range; however, only two are currently being used. Additionally, we could add more game modes to our existing ranges, such as an El Presidente mode to the classic range.

Beyond this, we also have expansion routes within the game modes that we already offer. For example, the Speed Test could be expanded to have randomized targets. Also, the Accuracy Test is set up to make adding new levels easy and thus could be reworked with a slower difficulty curve to facilitate adding more levels. It is also compatible with targets that move vertically and targets that move along the ceiling, something that has not been taken advantage of yet.

Besides the game modes, our Free For All section could be vastly expanded to include the ability to turn sets of targets on/off, introduce moving targets, change respawn times, etc. As for the weapons in this mode, the user currently does not have a good way to reclaim weapons that have accidentally been thrown, so some callback or weapon respawn would be a good added feature. Any other features that gave the user more control over this space would also be welcome additions.

Another significant addition would be the ability to save scores to some leaderboard (whether for personal use only or online as a competition between all those who play). This could be implemented in all of our game modes except for the Free For All, as that mode is more for practice instead of setting a new high score/low time. A leaderboard would make it easier to track whether you have improved since the last time you played and motivate users to get better and beat their previous scores.

References

We used the VR Interaction Framework from Bearded Ninja Games as a base for this project. This framework allowed us to focus on developing our app and its features, v.s. spending time implementing several weapons, targets, their related scripts, etc.

We also used the polygon sampler asset pack from Synty Studios for all of our scenery related work. This again allowed us to save on development time, as we only had to focus on moving elements around to create our scene, v.s. creating all of the elements, keeping a consistent theme within that design, etc.