VROARRR, Audio Based VR Weapon Design

G.S. Penninck(✉), N.S. Butler, M. Beardwood, D. Nash, T. Whaley, and M. Woods

Staffordshire University, Stoke on Trent ST4 2DF, UK
g.s.penninck@staffs.ac.uk

Abstract. To "roar like a monster" may be a dream of the average 8 year old; now you can: in a video game. VROARRR builds on audio capturing game mechanics within the play space of VR. The devised mechanics attempt to solve weapon design challenges such as fire rate, balancing, environmental damage and more. The devised system makes use of the Unreal 4 games engine and blueprint to teleport the user into a Monster Simulator.

Keywords: VR · UE4 · Audio · Weapons · Games design · Parameters

1 Introduction

Vocal Audio input features in many games, ranging from indie offerings such as Yasuhati [1], Panopticon [2], Gnilley [3] To triple A titles like Brain Age [4] and Singstar [5]. These games capture player vocals using a microphone in order to affect the game mechanics. In Yasuhati [1], for example, the audio data is used to traverse platforms; whilst Gnilley [3] uses captured audio as a means of attack.

This paper presents an approach to solving vocal weapon design challenges for a VR monster title. The Title referred to in the paper is VROARRR, a VR Vanguard competition entry. VROARRR lets the player play as a Giant Monster; its unique mechanic being a "roar" weapon (Fig. 1).

Weapon designs in games have several cliché design patterns, dubbed by David Perry [7] as;

- Target and Shoot
- Target Reticule
- Just Shoot
- Auto Target
- Lean and Fire

In VROARRR, the most appropriate cliché is "Just Shoot", Perry [6] explains this as "you just shoot in the direction you are facing. If there is an enemy in the line of fire, it's likely you'll hit it." The Audio Weapon in VROARRR fires from the centre of the Head Mounted Display (HMD). When activated, it fires projectiles in the direction the player is oriented.

In order to help communicate common trends and weapon classification, Giusti, Hullett and Whitehead [7] created the following set of design patterns for weapons in shooter games:

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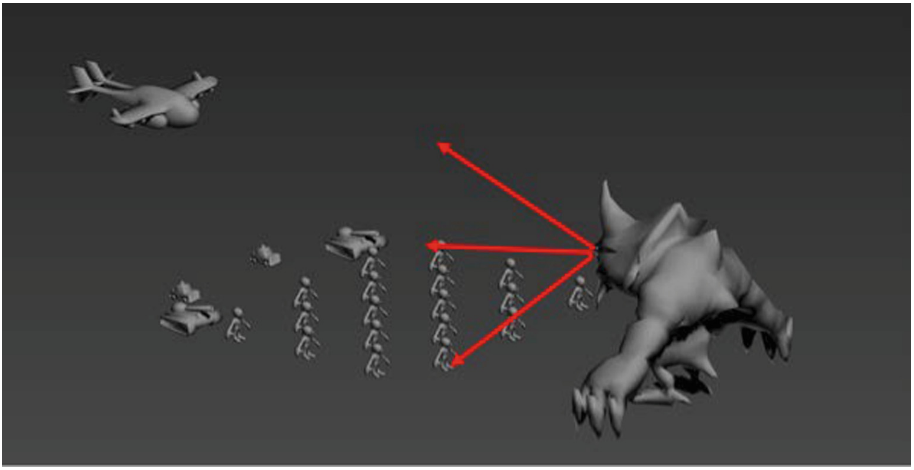

Fig. 1. VROARRR monster roar demonstration

- Sniping Weapons,
- Close Blast,
- Assault Weapon,
- Projectile,
- Power Weapon,
- Melee Weapon, and
- Placed weapon.

VROARRRs roar design pattern matches the "Assault Weapon" definition, as it fires quickly and accurately, based on the player's HMD orientation.

The VR and Audio Capture basis means that the roar Mechanic in VROARRR has significant differences to existing weapon design patterns. The player's vocal ability determines the weapon's fire rate, instead of a control pad trigger or a mouse button. It follows that the handling and control of the weapon is quite different, for example, to an Assault Weapon in Halo/Call of Duty Universes.

Therefore, the design decisions in VROARRR require modification when compared with traditional weapons design, these modifications which will now be explored.

2 Using the Microphone Input

Access to the audio stream in VROARRR was achieved by using Jackson's [8] VR Breath Test project for the Unreal Engine. Jackson's framework allowed easy access to the overall amplitude of an incoming stream, as shown in Fig. 2. Unreal allows for game play scripting and manipulation of the incoming audio stream data via the Blueprint Editor Epic Games [9].

Fig. 2. Jackson (2015) VR Breath test blueprint

3 Balancing Sensitivity Inputs

Jackson's [8] VR Breath test calculates amplitude via the collection of new audio samples every Tick. Ticks are an arbitrary unit of time and can be measured differently on hardware/OS, but on Windows a Tick represents one hundred nanoseconds (Microsoft [10]). The amplitude data passes through to Unreal which ticks every frame, therefore, without modification, the weapon would fire every frame.

In order to stop the roar from continuously firing, the amplitude data was limited by a mechanic shown in Fig. 3. The mechanic clamps the amplitude/Roar Level and compares it against a designated threshold. The clamps and multipliers at this stage were discovered via trial and error, during play testing the HMD. It is expected that the sensitivity will need to be controlled on a per user basis due to vocal differences and equipment sensitivities.

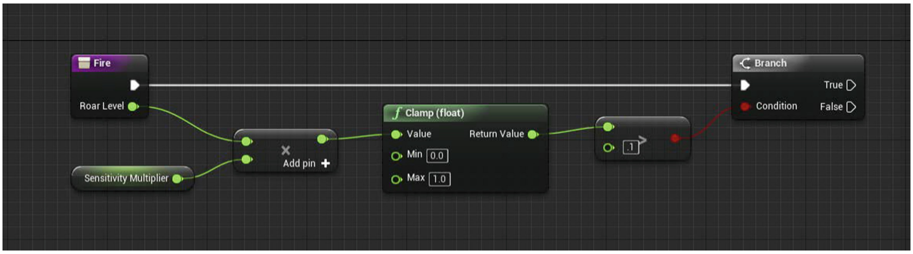

Fig. 3. Sensitivity mechanic

4 Balancing Fire Delays

With the sensitivity correctly balanced, there remained a high fire rate: the fire mechanic was being called approximately every 0.002 s, causing far too many projectiles to be spawned and enemies suffering instant death. A slower rate was required to aid game performance and balancing.

To deal with the amplitude data, a timer system was created as shown in Figs. 4 and 5. This cool down timer was triggered upon firing and a float was used to reset it to allow further firing. This system is not unique, the cool down timer is a ubiquitous mechanic in games, such as 343 Industries Halo 5 s [11] Plasma Rifles Overheat mechanic.

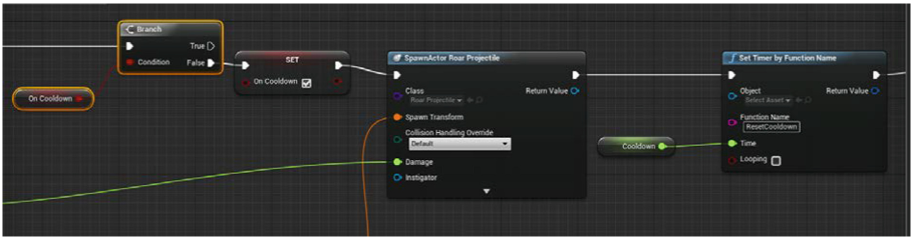

Fig. 4. Set cool down timer

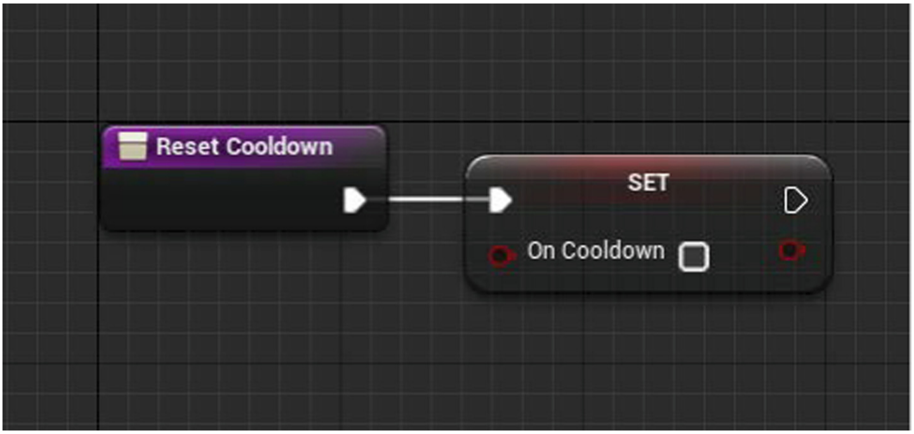

Fig. 5. Reset cool down timer

5 Managing Attack Particles

The projectiles in the VROARRR weapon spawn (Fig. 6) when a Roar had been triggered and the system is not on cooldown. The projectiles were chosen as a visual representation of:

1. the Roar power, and,
2. how the Roar interacts with the game environment.

Thus objects such as the Town Folk and Planes are all fully destroyable through collision with the roar projectiles.

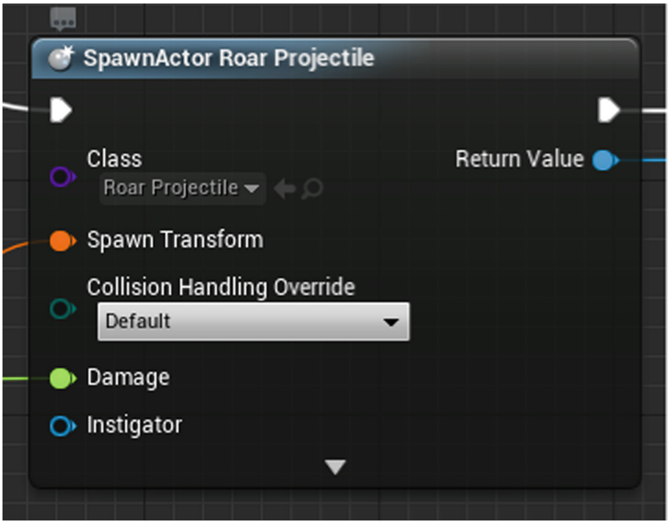

Fig. 6. Projectile spawn example

The projectiles presented a number of tricky design challenges, namely:

1. Scale
2. Damage
3. Amount
4. Speed
5. Appearance

Challenges 1 and 3 are problematic because particles that are too large or too numerous cause the HMD to become very visually "busy" for the player. A key principle of VR Design is comfort (Asforth [12]) so, where possible, particles needed to be controlled to ensure the HMD remained a comfortable visual experience.

To achieve this, a Cool Down strategy was employed once again, in conjunction with a scaling effect. Scaling in this instance produces particles that start off small and grow larger as they travel further from their spawn point. See Fig. 7 for the blueprint used to control this scaling action.

The damage of the projectiles was controlled by taking the initial roar level into account and clamping it between to values. This attempted to balance the damage based on the roar of the player, if this was not considered then frequent low amplitude roars would do the same damage as frequent high amplitude roars.

Figure 7 shows the overall appearance of the projectile, the art for this effect was mostly transparent. Several pulses emit from a sphere to give the player an idea of the directionality of the roar and the direction in which they are aiming. The visibility of the projects was designed with Asforth's [12] comfortable principle in mind (Fig. 8).

The final projectile challenge was speed, it was decided that the speed would remain constant regardless of amplitude as stated by NASA [13] it remains roughly

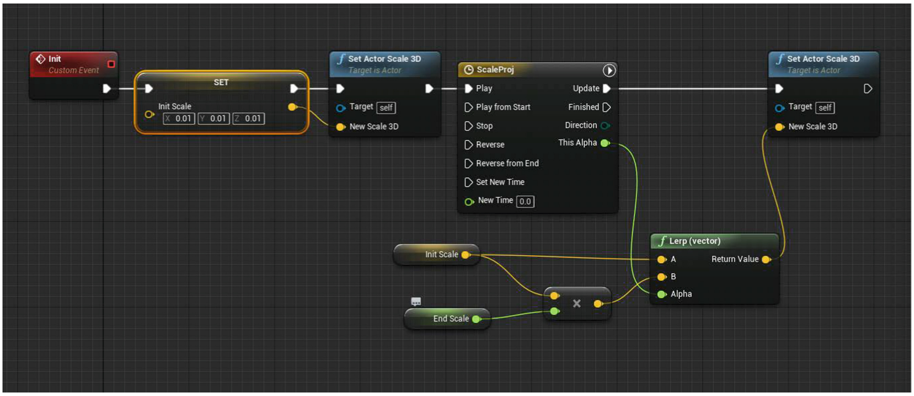

Fig. 7. Scaling particles over time

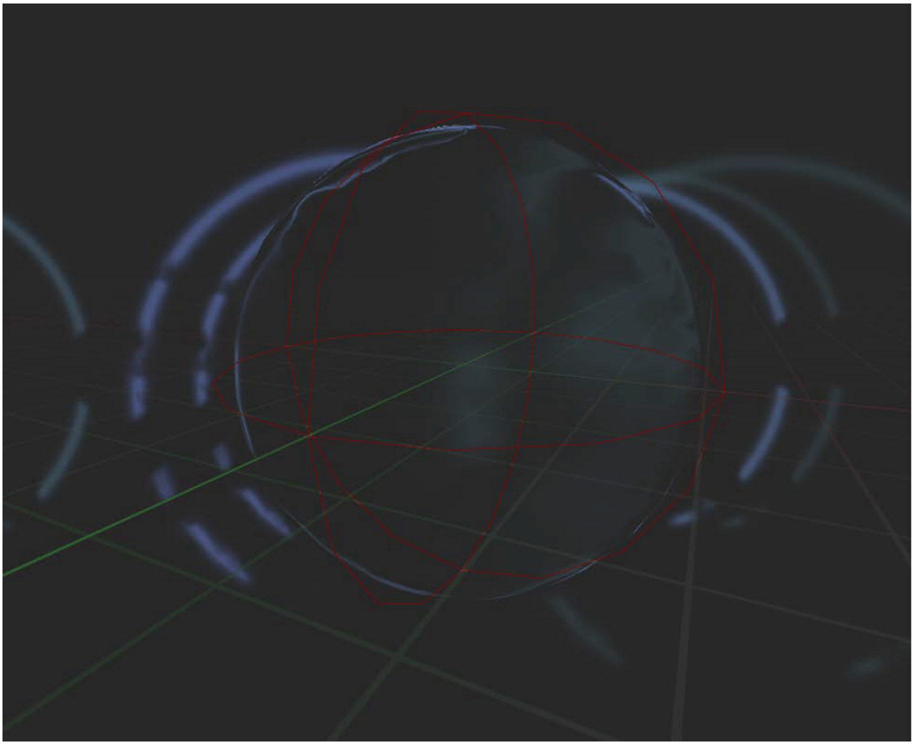

Fig. 8. Projectile appearance

constant within a medium. To get this to feel correct to the player many test plays were conducted until an appropriate speed was selected.

6 Damaging Enemies

The world in VROARRR is filled full of NPCs and vehicles such as aeroplanes. These entities can be damaged by the roar projectiles, as the roar weapon fires quickly a mechanic was devised to allow for a gradual application of damage (example shown in Fig. 9). The mechanic realised was a head enlargement to showcase the idea of the roar being really loud, this generated a progress bar effect of how damage an enemy (examples shown in Figs. 9 and 10).

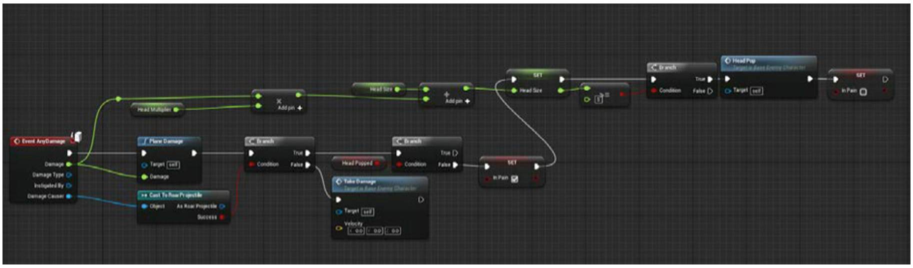

Fig. 9. Head enlargement

Fig. 10. Default grandma model

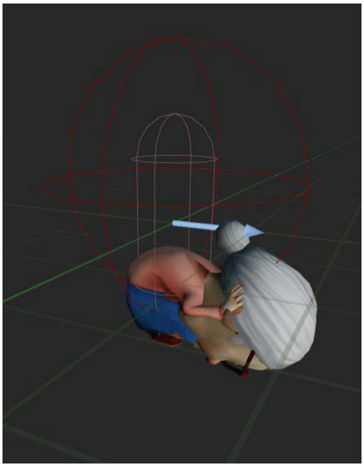

Fig. 11. Head expansion grandma

7 Environment Feedback

One of goals of VROARRRs roar was to try and create a feel of presence within the world. Ashforth [12] says with VR we are trying to help the player believe they are really in the game environment, teleported into the games universe. Up until this point the roar mechanic focused on everything but the environment. To help work with surrounding buildings a system was created whereby all the materials in game could be distorted by a wind effect. The result was such that the buildings would distort and animate with a large roar. A static example of this can be seen in Figs. 12 and 13.

Fig. 12. Static environment

Fig. 13. Material distorted environment

8 Deflection Mechanics

One of the final properties added to the roar mechanic was that of deflection. Satellite dishes were created that would deflect any incoming roar projectiles based on the facing direction of the satellite dish. This whilst interesting did not physically/accurately recreate the diffuse of sound waves but instead created focal points for the player to aim at.

9 Conclusion and Recommendations

Many of VROARRR's roar challenges lay within traditional weapon design;

- Fire rate
- Damage balancing
- Environmental effects
- Aiming.

Most of these challenges have been somewhat solved, but could certainly be taken further.

9.1 Fire Rate

The system does require calibration and can easily be cheated. A Loud hum or whistle will generate a similar weapon out as a large roar. Through testing it was noted that some players just did not want to be a roaring monster. Perhaps in this world there can be a whistling monster.

9.2 Damage

The current system is modelled completely on amplitude of the incoming audio data. This could be expanded to account for other audio properties such as pitch. The addition of pitch could create more variety in application of damage, for example a high pitch could shatter glass whereas a low pitch could move large buildings. This idea of variable damages may in fact solve the previous issue of fire rate as it will encourage the player to use their vocal range to solve problems.

9.3 Environmental Effects

The current environment effects are limited to vigorous distortion/shaking. The presence of the player in the environment is somewhat let down by the lack of building and environment damage. Additional systems here could help create a greater sense of presence.

9.4 Aiming

The positioning of the player and their scale in relation to the world does mean that player must be quite mobile to roar at lower targets. Whilst this is fun for a large spectrum of people it's not always comfortable which causes issues highlighted by Ashforth [12]. The test head set used during the production of VROARRR was a HTC Vive, the cable that connects to the computer would often cause players to get tangled/react cautiously. Future advances in wireless technology will certainly help the ability to aim smoothly.

Video of VROARRR https://www.youtube.com/watch?v=OEF-XpOeO0k

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