



Designing a Combat System for 3D Video Game

Project: Ripple in Dimensions

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ABSTRACT

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The idea for this thesis came from the need of designing a fun, functional and unique combat system for a game project, Ripple in Dimensions. The initial research revealed that combat systems are not a well-researched topic and that combat systems in general are often bundled with game design. This led to the first part of this thesis defining what a combat system is. The following part breaks down the core elements that can be used for one.

Research on combat systems was conducted by analysing multiple sets of games. These games were picked based on the similarities with each other and the suitability of the systems for the game project. Each game was analysed by breaking down their combat systems into simple elements. These elements were then categorized and compared with other games in the set to figure out which features were commonly shared between them, and which were unique to the game.

A new combat system was then designed for Ripple in Dimensions using the research data collected from the game sets. This was achieved by selecting common and well received features. These were then combined using the unique features into a complete system. This result can further be refined by estimating how difficult and time consuming each aspect of the combat system is and adjusting the features to better fit the scope of the project.

Key words: combat system, game design, video game, game mechanic

CONTENTS

1	INTRODUCTION	6
2	COMBAT SYSTEM.....	7
2.1	What is a combat system?	7
2.2	Defining a Combat System	8
2.3	Relation between combat systems and game genres.....	9
2.3.1	Turn-based and real time games.....	9
2.3.2	2D, 3D and 2.5D.....	10
2.3.3	Control methods	10
2.4	Supporting mechanics.....	11
2.5	System creation	12
3	GAME ANALYSIS.....	14
3.1	Introduction to games being researched	14
3.2	Touhou, Vampire Survivors, Enter the Gungeon.....	14
3.2.1	Touhou 10 ~ Mountain of Faith.....	14
3.2.2	Vampire Survivors	16
3.2.3	Enter the Gungeon	18
3.2.4	Comparing the games	19
3.2.5	What made the games successful?.....	20
3.2.6	Unique features	21
3.3	Dota Underlords, Legion TD 2, Loop Hero	22
3.3.1	Dota Underlords	22
3.3.2	Legion TD 2.....	24
3.3.3	Loop Hero.....	26
3.3.4	Comparing the games	28
3.3.5	Unique features	29
3.4	Furi, The Textorcist, Magicka	30
3.4.1	Furi	30
3.4.2	The Textorcist: The Story of Ray Bibbia	32
3.4.3	Magicka	34
3.4.4	Comparing features.....	36
3.4.5	Unique features	36
4	DESIGNING A COMBAT SYSTEM	38
4.1	What is Ripple in Dimensions?	38
4.1.1	Core design pillars.....	38
4.1.2	Limitations	38
4.2	Choosing suitable mechanics	39
4.2.1	Attack style	40
4.2.2	Health	41

4.2.3 Movement.....	42
4.2.4 Enemy behavior.....	42
4.2.5 Additional mechanics.....	43
4.2.6 Summary.....	44
4.3 Implementation challenges	45
4.4 Implementation roadmap	46
5 DISCUSSION	47
REFERENCES	48

TERMS & ABBREVIATIONS

CCG	Collectible Card Game
RPG	Role Playing Game
CRPG	Computer Role Playing Game
FPS	First Person Shooter
D20	20-sided die
RTS	Real Time Strategy
4x	Subgenre of strategy games: “explore, expand, exploit, and exterminate”
Unity	Game engine used for creating games
Metroidvania	Subgenre of action-adventure games
VR	Virtual Reality
Steam	Game distribution platform
SteamDB	Third-party website for tracking game statistics
Bullet hell	Subgenre of Shoot ‘Em Up games
Iframe	Invulnerability frame, short period of immunity

1 INTRODUCTION

CCG, RPG, strategy, FPS, board and many other games and genres have one thing in common that keeps the player engaged. That is their combat system. There are some exceptions to this, for example a diving simulator game might not get any value from adding one into the game. However, if the diver were in an alien planet and able to swing a knife to fend off hostile creatures, the game now needs a functioning combat system.

Other examples of this could include playing a card that deals damage to opponent in Hearthstone, using flash in League of Legends or doing a stealth attack in Skyrim. All these actions are experienced vastly differently by the players. A combat system can utilize features from multiple different game genres and utilize other aspects of the game such as environmental design to achieve more interesting results.

Combat system is one of the core pillars that determines how the game feels to play for the user. There are many beautiful games that could have gained vastly larger audience if their gameplay didn't feel so awful that it made players quit during the tutorial. The games that have built systems that feel good to use and bring something unique that hasn't been seen or executed well before, have found success in indie landscape. Some examples of these could include Undertale, Crypt of the Necrodancer, Slay the Spire or Darkest Dungeons.

2 COMBAT SYSTEM

2.1 What is a combat system?

The definition of combat system can vary based on who the responder is. For players this can mean how difficult the battles are, does the game feel good to play or are the battles rewarding enough. This is a different perspective to what game developers have.

Lead combat designer of Santa Monica Studio, known for God of War games, Mihir Sheth (How do you make hitting something fun? 2021) compares combat to chess. Combat team is responsible for creating individual chess pieces and encounter team the chessboard. It can be seen as creating a puzzle and giving the players the tools for solving it.

Atticus Evil, Creative Director from Grumpo Games (Game Combat Systems, 2015) talks about combat systems in tabletop games. His article shows concern about narrative elements and D20 rules slowing down the combat too much. Based on this perspective, everything from the beginning of players first turn to victory is considered a part of a combat system.

For players, combat system is usually term they have heard but confuse it with other features. It's often bundled with "Gameplay" when discussing this topic and rarely brought up separately unless there's something wrong with it. One of the games that bring up conversation about combat systems is Witcher 3. Most of the player criticism is centred around combat being weightless, repetitive, and unresponsive. (Why is the Witcher 3's combat criticized or consider weak? 2017).

"The main objective we have in mind when we design the gameplay mechanics of a combat system is to push the player to make clever choices and use the right ability at the right time." (Lambottin 2012).

2.2 Defining a Combat System

Combat is a combination of various pieces that together form a whole experience. Combat itself can usually be relatively easy to define, for example “Play cards to win your opponent” or “Send units to defeat enemies”. A game doesn’t necessarily have combat in it but if it does, a combat system is necessary.

In Pac-Man, there are multiple ghosts hunting the player. The game will end if they touch the player’s character. However, if the player manages to pick up a special orb, the ghosts will become vulnerable, and the player can run over the ghosts to get rid of them. In this case, picking up the special orbs, having the ghosts chase the player and moving over the ghosts would be considered game mechanics. All these together form a combat system.

In this thesis, combat system is defined as a framework which is built from various game elements that contribute to combat. This can for example include how the player character is controlled, what tools they have available to them, how character progression affects abilities or how enemies behave. Games don’t have to follow any rules when it comes to these features so the combat systems can vary a lot between different games and genres.

The values of individual game mechanics don’t affect the combat system. It doesn’t matter if player has 50 or 100 health, what matters is what that health is used for. Mechanics can be tweaked, added, or removed from the system at will. What matters is that the selected game mechanics work together. For example, a double jump could be added to the game increasing jump height. If this lets player get high enough so that the enemies can’t reach them it could be detrimental to overall balance of the game.

2.3 Relation between combat systems and game genres

Games of same genre tend to utilize similar mechanics in their combat systems. For example, most of the RTS games are very similar to each other, requiring player to control large quantities of units while having their attention spread in multiple parts of the map to either attack or defend key locations. Another good example are FPS games where the main gameplay is controlling a character with a gun and the combat relies on players reflexes to be the fastest one to shoot the enemy.

2.3.1 Turn-based and real time games

Easiest way to divide games is by separating them to real time and turn based. Turn based games tend to give player a very long time to figure out what to do on their turn, usually limiting the number of actions a player has. Real time games in the other hand react to player input immediately and they usually don't give player much time to think about their next action. Some hybrid variations of these exists but the general division can usually be made easily.

Turn-based systems are generally used in games that have complex systems that require thinking on how to execute a turn properly. Games such as Chess, card games like Hearthstone, CRPGs or 4x games are good examples of games that tend to work very well with turn-based models. These games usually have the player controlling multiple characters or utilize a large quantity of cards to create complexity to combat.

Most of the game genres fall under real time category. Some good examples are action, FPS, RTS or RPG games. It's possible that these games include a feature to pause the game, but this doesn't exist when the game is multiplayer. Combat in these games is often hectic and requires split second decisions from the player. The combat systems tend to be simple with emphasis put on the player movement.

2.3.2 2D, 3D and 2.5D

While 2D game can be translated to 3D relatively easily, the conversion might not work other way around. It's very challenging to create a first-person game in 2D. Some examples of games that have succeed in this are the early 90s dungeon crawling games, but those have very limited movement and arguably use 3D space. Creating a 2D game nowadays is easier by using a 3D engine. Unity documentation defines 2D games as games that use sprites without 3D geometry while having orthographic camera.

The main limiting factor when it comes to combat in 2D games is missing the third dimension. This is especially noticeable in games that require aiming and leads to trajectories being a common way to make gameplay interesting in games like Angry Birds and Worms. Movement is another limiting factor; however, it does have its advantages. Metroidvania genre has had great success using orthographic camera and requiring player to utilize precise inputs to get past challenges thrown at them. Hollow Knight is a great example of a 2D game that has gained massive popularity.

2.5D works technically the same way than 2D games while using 3D models. Identifying these can be done by asking the question "Is there a third axis?". If the axis exists, it's a 3D game. New Super Mario Bros is an example of a 2.5D game. While not bringing anything new to 2D genre, these games can be a lot easier to make than 2D games due to sprites requiring tremendous amount of work.

2.3.3 Control methods

Controlling the game can be a huge factor on how the game feels to play. Some of the devices are more suited for accuracy whereas others give a better sense of immersion. The current gaming landscape can mainly be divided into three categories: PC, console, and mobile games. Out of these, mobile is considered the easiest to develop for, due to input and hardware limiting the complexity of what can be achieved. Mobile games can often be ported to different platforms

relatively easily. Their primary control method is based on tapping and swiping the screen.

Consoles could be considered as lightweight PCs when it comes to the games that they can run. A generic console controller has 2 sticks, one generally used for movement and the other for camera control, a D-pad, and varying number of basic buttons for input. These controllers provide haptic feedback for player that can greatly increase the immersion of games being played.

PCs in most cases have a mouse and keyboard available. The important part with these is to understand that the layout of devices can vary a lot depending on manufacturers and users' country. For example, some keyboards don't have a numpad and some mice are missing a wheel. Providing customizable controls is a great way to make sure the game is playable for everyone.

There are various other peripherals that aren't platform specific, although their support is usually better on PCs. Some examples of these are racing wheels, pedals, VR controllers, dance pads, joysticks, microphones, fitness peripherals or eye trackers. Many of these are very niche with the user base being somewhere in thousands so it's not financially viable to develop games for those devices. It should however be noted that some players in specific genres such as fighting- or rhythm games tend to prefer using specific devices better fit for them like arcade fight sticks or drawing tablets. Providing support for these can be very beneficial for the potential players.

2.4 Supporting mechanics

Games are built from systems. Smaller games can get away with only a couple of them whereas larger games can have dozens of different systems. Most of these systems might have nothing to do with combat directly but could affect it in one way or another. For example, harvesting and cooking food is not combat. When player then eats that food and gains health regeneration in fight, that directly affects the difficulty of combat.

When designing a combat system, it's important to take in account the other game systems and mechanics. Game mechanics can be defined as features that have consequences and can interact with other mechanics. Understanding what mechanics are requires being able to separate them from cosmetic effects. (Video game mechanics: A beginner's guide). If an explosion happens but it doesn't affect any relevant gameplay elements or deal damage, it's cosmetic, not mechanic.

RPG games tend to use systems such as character levels, equipment, consumables, or customizable abilities to affect the outcome of battles. If there is a challenging enemy coming, the player could be given a save point or health potions right before it. In some games, even the environment can be used to give player an advantage. For example, in the first Dark Souls game, the player faces a minotaur in a narrow pathway. If they turn around right after starting the fight, they can climb a tower and do a plunging attack taking down half of the minotaur's health.

While these supporting mechanics can be completely optional, some of them can change the way combat works. For example, Witcher games allow you to use potions and poisons to drastically alter the way battles work and Elden Ring lets you ride a horse while fighting certain enemies. While these aren't individually combat mechanics, being able to use them in combat scenarios make them supporting mechanics.

2.5 System creation

When creating game mechanics, it's important to have a clear framework of what is being created. Each system has certain mechanics that they require to function and properly prioritizing them will make the creation process smoother. Using tower defence game as an example, what the game needs to function on a very basic level is a tower that can shoot enemies and an enemy unit. The tower requires an attack which deals damage. The enemy requires health that can be reduced with that tower attack. Once these have been completed, the next step would be to make the enemy move and make that attack land on the enemy.

While combat system is a combination of various mechanics, the mechanics that form the core of it should be created in a way that they support each other and allow expanding upon. When creating new mechanics, it's important to ask whether they enhance the playing experience or not. Is pressing a button to climb a hill necessary if the player can already jump?

As for the creation process itself, it's sometimes possible to avoid unnecessary work by utilizing premade assets. Game engines tend to have asset stores where users can find free or paid asset packs. These can be modified to fit various use cases and make the workload much smaller. The assets can be especially useful when adding supporting mechanics that don't directly affect the playing experience. However, if the goal is to create something unique, it might be easier to code that from scratch rather than trying to bend a premade asset pack to fit the project.

Using free assets from the store can also be tremendous help when prototyping features. They allow for quickly testing certain features that would take a long time to code from scratch, such as creating a character controller. Even if these features are planned to be done better at later date, being able to use them as a placeholder can allow other team members to test their work in the game environment.

3 GAME ANALYSIS

3.1 Introduction to games being researched

Games used for this part were selected primarily based on their suitability for the design task of the project. It's a top-down Shoot 'Em Up game, specifically in bullet hell subgenre. The goal of this research is to find alternative and unique ways of expanding the genre to be more engaging. Selected games include other bullet hells, auto battlers, action, and roguelike games. The games were categorized by picking three similar games to each other. All the selected games are in Steam marketplace due to ease of access to statistics such as player numbers and reviews. They might have other release platforms, but these will not be included in the analysis.

3.2 Touhou, Vampire Survivors, Enter the Gungeon

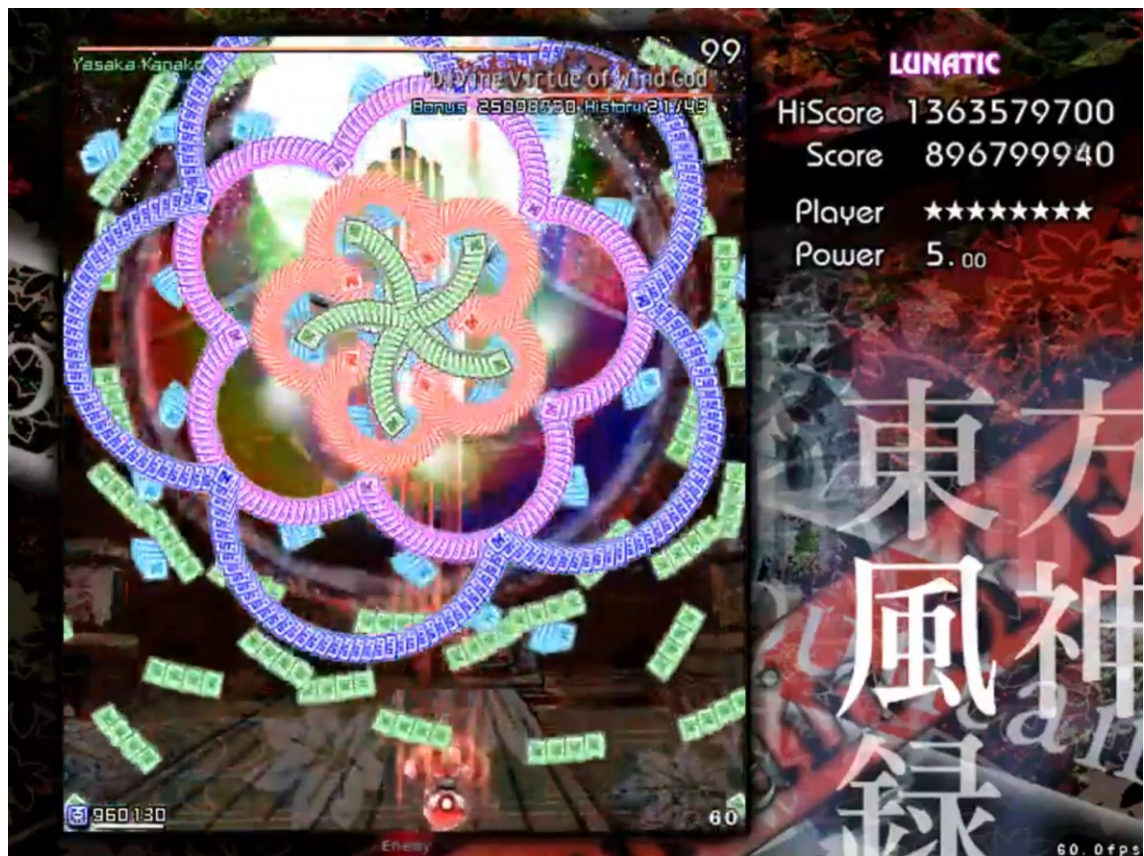
These games can all be categorized under bullet hell genre. The term bullet hell comes from player constantly having to avoid numerous enemy projectiles to survive. Bullet hell games are a subgenre of Shoot 'Em Up games and were originally created to compete against increasingly popular 3D games in early 1990s. (Ashcraft 2008). Their core gameplay loop revolves around collection of power-ups and defeating hordes of enemies.

3.2.1 Touhou 10 ~ Mountain of Faith

Touhou Project games have a long history starting around the end of arcade game era in 1995. Mountain of Faith is 10th Touhou game released in 2007 and later in Steam June 2020. While it's difficult to estimate the total number of copies the game has sold during its lifespan due to it being originally distributed with CDs and widely downloaded from other sources, SteamDB gives an estimate of 50 000 copies sold on Steam. There are 506 reviews in Steam with 100% of them being positive.

The game starts by letting the player choose one of the two playable characters. These characters each have three different shot types. These types are homing, forward focus, sealing, high-power, piercing and magic-user. Each one of them has two different modes, focused and un-focused. The game lets player swap between focus modes depending on if a key is held down, resulting in the attack pattern changing and character slowing down. Focus mode also displays the character hitbox on top of it, making dodging enemy bullets easier. In general, the focus mode is used when trying to target down a single enemy and unfocused mode is for faster movement and wider attack range.

Gameplay itself is very straightforward. Character is controlled using arrow keys with only other buttons being shooting, activating the bomb and focus mode. Goal is to beat all levels and each level has waves of enemies, mini boss, and a boss (Picture 1). There is no variation in the way enemies act which leads to every level being the same on separate playthroughs. Player starts with 2 lives and 0 power, these can be increased by collecting items dropped by enemies. Lives are lost when getting hit by enemies and power determines how strong the players attack is. For each power level, an additional orb is added that shoots enemies, up to 5. One power level can be spent to activate a bomb that deals screen wide damage and clears all enemy projectiles.



PICTURE 1. Touhou boss fight.

Player performance is calculated with a scoring system. There are various elements that are included in the calculation, such as the location of picked up point cards, time, point multipliers, power, and clear bonus. If the player runs out of lives, they get the option to continue the game, but this will put them at the beginning of current level and resets the score.

3.2.2 Vampire Survivors

Released in early access late 2021, Vampire Survivors gained a huge popularity after becoming popular among content creators. With 99% positive steam reviews and estimated 1 million players, it quickly became one of Steam's top selling games. The game itself is very easy to get into and offers the players action packed gameplay sessions that last less than 25 minutes depending on level.

When starting the game, player has an option to pick which character to play and customize upgrades. These are unlocked with gold that can be earned by playing the game, making it play like a roguelike. The game itself borrows elements from

bullet hell genre while appealing to more casual audience. Goal is to survive hordes of enemies for around 25 minutes with some of the levels having shorter playtimes. Player moves around with directional keys and automatically shoots projectiles based on which powerups they have (Picture 2).



PICTURE 2. Vampire Survivors gameplay.

Powerups can be earned by leveling up the character and further upgraded by finding lootboxes dropped by enemies. These powerups can be split in two categories: offensive and passive. Offensive powerups such as various attack types like fireballs, throwing axes and auras are used to directly increase player power. Passive powerups provide indirect buffs including extra health, longer pickup radius or more projectiles.

There are various other items dropped by enemies, such as food to restore health, magnet to collect experience crystals or time stops. While the combat itself requires very little attention, the primary complexity of the system comes from decision making. Selecting correct power ups leads to them combining and becoming more powerful and saving food items when health is low leads to longer survival. Positioning does matter especially when facing against stronger boss enemies when letting them reach the player can be fatal.

3.2.3 Enter the Gungeon

Selling over 200 000 copies on its first week of launch in April 2016 and over 3 million copies by 2020, Enter the Gungeon is a very successful roguelike bullet hell game. The public reception has been overwhelmingly positive with 94% of the Steam reviews being positive. Most of the negative reviews criticise the game for being too difficult and lacking the feeling of progression due to heavy randomness involved in weapon drops and the lack of character progress outside of game sessions that other roguelikes tend to have.

Player gets to choose between 4 starting characters and later 4 more unlockable ones. The only difference between characters is the way they look and which weapons and items they start with. They are then thrown into a randomly generated dungeon which consists of various floors with enemies, shops, treasure chests and boss fights (Picture 3).



PICTURE 3. Enter the Gungeon boss fight.

Player has a dodge roll which allows them to avoid bullets and traverse gaps with correct timing. Interact button can be used for talking to NPCs or activating various objects around the dungeon, such as knocking down tables for cover. There is a button for swapping weapons, holding it down slows time to let player choose which weapon they want to equip. Reloading happens when a gun runs out of

ammo or when player presses the reload button. It's possible to collect shells that can be used to clear the screen from all bullets, like the bombs in Touhou.

Due to the game having very large variety of different enemies, weapons, buffs, and bosses, it has a steep learning curve. The levels tend to start with easier enemies in them and progressively get harder the further player progresses in game. Players have various resources including health, shells, bullets, currency, and keys. Currency can be used in the shop rooms to purchase other resources and powerups.

3.2.4 Comparing the games

While the core idea of these games is very close to each other, their gameplay varies a lot from each other. Touhou and Enter the Gungeon are closest to each other with both games revolving around dodging enemy bullets while focusing on aiming at enemies to deal damage. The biggest difference between these 2 is their movement systems. Touhou is a scrolling shooter where player is only able to shoot forward, and the movement is confined to a smaller space. Enter the Gungeon is free form, allowing the player to shoot and move at any direction they wish. Vampire Survivors is like Gungeon, with the difference being the lack of dodge feature and shooting being automatic.

All the games offer ways to power up the character with different weapons and buffs found while playing. Touhou takes a more traditional arcade approach with weapon type being selected in character selection screen and powerups being limited to making that weapon better. Vampire Survivors provides the player constant positive feedback loop by providing new powerups on each character level and constantly giving away loot boxes to upgrade them. Enter the Gungeon has a much wider variety of weapons than the other 2 with added importance on swapping the weapons during gameplay due to ammo being a finite resource.

Health is another big dividing factor in these games. Vampire Survivors uses a basic health bar system where HP starts going down when enemy touches you. It's possible to survive for a short period of time depending on the difficulty of touching enemy. Enter the Gungeon provides player with a few HP crystals with

enemy bullets dealing varying amount of damage. When player gets hit, they have a short period of immunity and can clear the screen of bullets if they have armour. Getting hit in Touhou removes 1 life, drops player power which can then partly be picked up again if done in time and makes the player invulnerable for a short period of time. Losing all your lives results in having to restart the game in Vampire Survivors and Enter the Gungeon. Touhou gives you an option to continue from beginning of the stage.

TABLE 1. Feature comparison

	Touhou	Enter the Gungeon	Vampire Surv.
Movement	Limited	Free form	Free form
Shooting type	Active	Active	Passive
Health	Lives	Lives	Amount
Power Ups	Weapon power	Various	Various
Dodge	No	Yes	No
Difficulty	Multiple	Single	Single
Out-of-level progression	No	Weapon & powerup unlocks	Stat increases

3.2.5 What made the games successful?

For Vampire Survivors, its appeal comes from very easy accessibility. Bullet hell genre has been seen as appealing to niche hardcore gamer audience but it's obvious that this is not the case with this game. Anyone can pick up the game and get progress with some luck. It's also a comfortable game to watch in video or stream format, making some of its rapid popularity come from content creators. The constant drip feeding of rewards keeps the players engaged throughout play sessions.

Enter the Gungeon was one of the early adopters during roguelike popularity boom. In PCGamesInsider interview (How Enter the Gungeon reached 1m sales 2017), producer/designer Dave Crooks mentions the reasons for their success being game being good, release timing and content creator influence. One of the main draws of the game is the vast amount of weapons and power ups that make

each gameplay session unique. Combined with procedurally generated dungeons, the highs player experience during gameplay by finding overpowered combinations feel really good. In the other hand, getting unlucky can feel demoralizing to some and may lead to them quitting.

Touhou 10 ~ Mountain of Faith has its roots as a series in the early PC era when arcade games started becoming less popular. It attracted a dedicated fanbase in Japan and offers a huge variety of fan works ranging from music to art and even spinoff games. ZUN, the creator of Touhou games, has always targeted a hardcore audience with the series. Although the games offer various difficulty levels, even the easy mode is seen as more difficult than almost anything else on the market. Most of the games in the series offer very similar gameplay to each other, mainly tweaking certain features such as bomb generation and shoot patterns, to provide variety. Mountain of Faith had its game engine and pacing overhauled from its predecessors and gameplay elements streamlined. What makes Touhou games stand out the most is their visual appeal, music, and tightly tuned difficulty of stages.

3.2.6 Unique features

All these games are a part of bullet hell subgenre, so their unique features are those systems and mechanics that derive from other games withing that subgenre. The following unique features will be listed based on their contribution to the combat system.

Vampire Survivors is the most casual out of these three games and its unique features are:

- Automatic shooting
- Very easy to play, difficulty comes from game knowledge
- Constantly rewarding gameplay

Enter the Gungeon targets midcore gamers that are familiar with roguelike mechanics and enjoy challenge. Its unique features are:

- Using environment as advantage

- Dodge roll
- Weapon swapping and reloading

Touhou is targeted for the hardcore audience with its unique features being:

- Toggleable focus mode
- Various ways to influence score by adjusting playstyle
- Long play sessions
- Very little randomness

3.3 Dota Underlords, Legion TD 2, Loop Hero

This category is interesting due to these games being from different genres. Dota Underlords is from auto battler genre, Legion TD 2 is a tower defence game and Loop Hero is closer to a traditional RPG. What ties these games together is the fact that none of them require player input for combat. All of them have a separate preparation- and combat phase which allows player to take their time planning on best outcome for the upcoming fights.

3.3.1 Dota Underlords

Having its roots in the map modding scene of Warcraft 3 and DotA 2, Dota Underlords is Valve's response to the massive surge of popularity auto battler genre gained in early 2019. Underlords had its early access release in June 2019 and was later officially released in February 2020. The game saw an initial surge of players during its early access launch but quickly fell off after Teamfight Tactics was released later that month targeting the same audience and offering the players something new that wasn't a direct copy of DotA 2's custom gamemode Auto Chess.

The goal of Underlords is to be last player alive. Each game session consists of multiple rounds and each round has a preparation and battle phase. During a preparation phase (Picture 4), player can purchase units, place them on the field

and give them items. There is a limit on how many units can be placed simultaneously based on the current level of player. Levels can be earned passively from finishing rounds or bought with currency. Currency can also be used for rerolling the list of units in shop.



PICTURE 4. Underlords preparation phase and shop UI.

Items can be obtained every 4th round and on first round. They can be split into equippable, global and contraptions. Equippable items are those that are given to units and provide benefits to that unit, such as more damage or health. Global items provide team wide buffs like cheaper units. Contraptions can be placed on the field with units and can have effects like healing units around them. There are 5 different tiers of items and the probability of finding higher tier items goes up based on current round.

The combat phase is completely played by AI, player can't influence the outcome of fights in any way. It's possible to increase the likelihood of winning the opponent by adjusting the team composition during preparation phase by placing units in better locations or giving items to different units. Most of the strategy in game comes from game knowledge and economy. Knowing when to spend currency, where to place the units, and keeping track of enemy team compositions play crucial role in winning the rounds.

Units have levels, tiers, and alliances. Unit levels can be increased by purchasing multiple copies of same unit, a 1-star unit combining to a 2-star unit when player owns three copies and a 2-star unit combining to 3-star with three 2-star units. Tiers are predetermined and higher tier units can be acquired from shop by increasing the player level. Alliances are buffs that activate when multiple units from same alliance are on field at the same time. Units have various attack styles and abilities. In general, they generate mana by doing normal attacks. When mana bar is full, they will cast a skill reducing the mana back to 0 and placing that skill on cooldown.

3.3.2 Legion TD 2

Like Dota Underlords, Legion TD started as a custom map in Warcraft 3. Early access for Legion TD 2 started late 2017 and the game was officially released October 2021. While failing to attract a huge audience to the game and having only 85% positive reviews in Steam, Legion TD 2 has its dedicated fanbase averaging around 2000 peak concurrent users daily according to SteamDB. The game offers 2v2 and 4v4 multiplayer modes and a campaign for single player and co-op experience.

Like other auto battler games such as Dota Underlords and TFT, game sessions in Legion TD 2 consist of building phase, as seen in Picture 5, and battle phase. The units are placed on a grid, and they will execute the action phase without player input. What makes Legion TD 2 stand out from other tower defence and auto battler games is its wide variety of buildable units and a unique approach to economy.



PICTURE 5. Legion TD 2 building phase.

Each wave of enemies consists of predetermined set of units and mercenaries. Players can choose to send additional mercenaries to their enemies, sometimes drastically altering the difficulty of waves with the goal of getting past the enemy defences and killing the king to win the game. The challenge comes from finding a correct balance of units while investing extra resources to bolster the economy. The economic structure can be seen in Picture 6.



PICTURE 6. Economy structure in Legion TD 2 (Legion TD 2 Official Gameplay Guide).

3.3.3 Loop Hero

While Loop Hero might initially seem like a weird pick to compare with the other two games in this section, the gameplay at its core is very similar. Released in March 2021 Loop Hero became very popular among content creators and has sold around a million copies in Steam during its first year based on SteamSpy estimates. The player reception has been good with 94% of the reviews in Steam being positive.

Loop Hero is a roguelike game that utilizes a deck building system and traditional RPG itemization for the player character. The combat in this game doesn't require any player input and is handled by computer, shown in Picture 7. The player can influence outcomes of battles by placing tiles in a way that supports character growth and by equipping stronger items after they are found.



PICTURE 7. Loop Hero combat.

The tiles are divided in 4 categories: Road, Roadside, Landscape and Special. New Road tiles are generated based on which roadside tiles are placed down and the synergy between them. This could include placing a vampire mansion next to a village which leads to that village becoming a ransacked village, spawning stronger enemies with better loot. Landscape tiles generally provide player passive benefits such as increased damage and generate resources to be used after finishing the current play session. Special tiles have effects such as increased movement speed in their vicinity.

The game runs by itself and allows the player to modify its speed. It's possible to pause at any time and place more tiles or equip another item. Player character follows a set path that can be seen on Picture 8. After a round of loop is finished, the hero will heal, and the player is given an option to retreat keeping all their resources or keep going.



PICTURE 8. Loop Hero playing area.

Players can earn resources while playing which can be spent after dying, retreating, or defeating the boss of current loop. These resources unlock more tiles, playable characters, and passive benefits. Each loop has a certain build limit and when the maximum is reached, a boss will spawn. These boss fights will always happen when the current loop is finished. If the player is successful at defeating the boss, they will unlock the next, more difficult map.

While the game itself is very simple, it does offer a lot to think about. Placing a tile has lasting consequences and can quickly lead to situation where enemy fights are too difficult for the player to handle. However, if done properly, this can lead to gaining powerful equipment. Each hero has their unique combat style and equipment stats making swapping between them interesting. A warrior focuses on health, counter damage, and defence while necromancer summons skeletons to fight for them. A rogue evades attacks, has high critical hit chance, and gains extra loot from fights.

3.3.4 Comparing the games

Original Legion TD is arguably the game that started and popularized the auto battler genre, leading to games such as Dota Underlords years after its creation. It has certain rough features that mainly affect the accessibility of the game with a lot of them being fixed in Legion TD 2 and further refined in other auto battlers that came after it. The fact that Legion TD 2 has all its rounds against NPCs instead of other players units might be the main reason for its lack of popularity.

When it comes to combat, all these games share similar pacing. Each game has a planning phase and a combat phase. For Legion TD 2 and Dota Underlords, these phases are timed due to them being multiplayer and in Loop Hero player can choose how fast they want the game progress or pause at will. While Legion TD 2 doesn't offer items that can be equipped for units, it makes that up by allowing player to upgrade the units with currency. Legion TD 2 is also the only game that has an active economy structure generating resources during the gameplay.

Loop Hero is the only game which allows player to increase the power of their character outside the active playing session by providing passive upgrades. Dota Underlords and Legion TD 2 starts every player from same line when a new game begins with the only differences being cosmetic. While the winning and losing conditions are similar in each game, the pacing is what makes them stand out from each other. Dota Underlords is designed in a way that losing rounds slowly

chips away from players total health whereas Legion TD 2 and Loop Hero could end up very fast if played incorrectly.

TABLE 2. Feature comparison

	Dota Underlords	Legion TD 2	Loop Hero
Economy	Interest & Streaks	Interest	No
Upgrades	Random	Predetermined	Semi Random
Equipment	Yes	No	Yes
Health	Lives	Upgradable unit	Amount
Difficulty	Easy to learn	Hard to learn	Trial and error
Out-of-level progression	No	No	Passive buffs and new tiles

3.3.5 Unique features

While Dota Underlords and Legion TD 2 can be categorized under auto battler genre, Loop Hero has features that can affect the outcome of battles while they are happening deriving it from that genre. Loop Hero gameplay is very close to the other two so comparing them within that genre makes sense. Following features make each game stand out from others.

Dota Underlords has its roots in Legion TD but the things it has improved on are:

- Good accessibility with possible upgrades highlighted
- Passive economy based on current gold held, round bonus and victories
- Strong IP behind it from DotA 2
- Touch friendly interface for mobile users

Legion TD 2 is built with RTS rules in mind from Warcraft 3 and has added previously impossible features such as rankings and single player modes. What makes it stand out are:

- Unique economy system that requires balance between units and workers
- Sending units to opponents with mercenary system
- Cooperative gameplay in 2v2 and 4v4 modes
- Player health is tied to the king unit that can be upgraded

Loop Hero did surprise many players with how fun it is while having very basic controls. What's unique about it is:

- Building your own adventure with tiles
- Possibility of greatly affecting gameplay with deck choices
- Progressive equipment upgrades that feel good
- Able to pause the game whenever needed

3.4 Furi, The Textorcist, Magicka

While having a vastly different gameplay to each other, the games in this section do share some similarities with each other. Furi and Textorcist are both close to bullet hell genre with focus on boss fights. Magicka is more about surviving ally projectiles rather than avoiding enemies. The main reason for selecting these games for comparison was how unique their gameplay feels like. Fury is closest to a traditional action game with combat relying on timing attacks, Textorcist is played by typing words and Magicka uses an elemental combination system for spells.

3.4.1 Furi

Released in July 2016, Furi quickly gained popularity for being a very challenging action bullet hell game offering the player a few hours of gameplay. It's estimated to have sold over a million copies on Steam and has a good 90% positive review score. Most of the criticism for the game revolves around it being too difficult and punishing.

Furi focuses on tightly tuned, increasingly difficult boss fights. Each boss has multiple phases with varying attack patterns. The player has two different attack styles: melee and ranged. Both styles have access to a charged attack that deals increased damage and when used with ranged attack, can pierce through projectiles. Each enemy attack has different way of countering it. Most bullets can be

shot with ranged weapon and melee attacks parried. If neither of this work, it's possible to dash with length based on how long the button is held down.

Player and enemy health are displayed as a bar in top corners of the screen. The squares under that bar present remaining lives (Picture 9). If the health bar goes to 0, a life is lost, and the current boss phase will start from beginning. When all lives are consumed, the player must restart that fight from beginning. For bosses, each live represents a new phase and when phase ends, player HP is healed to full, and 1 life recovered.



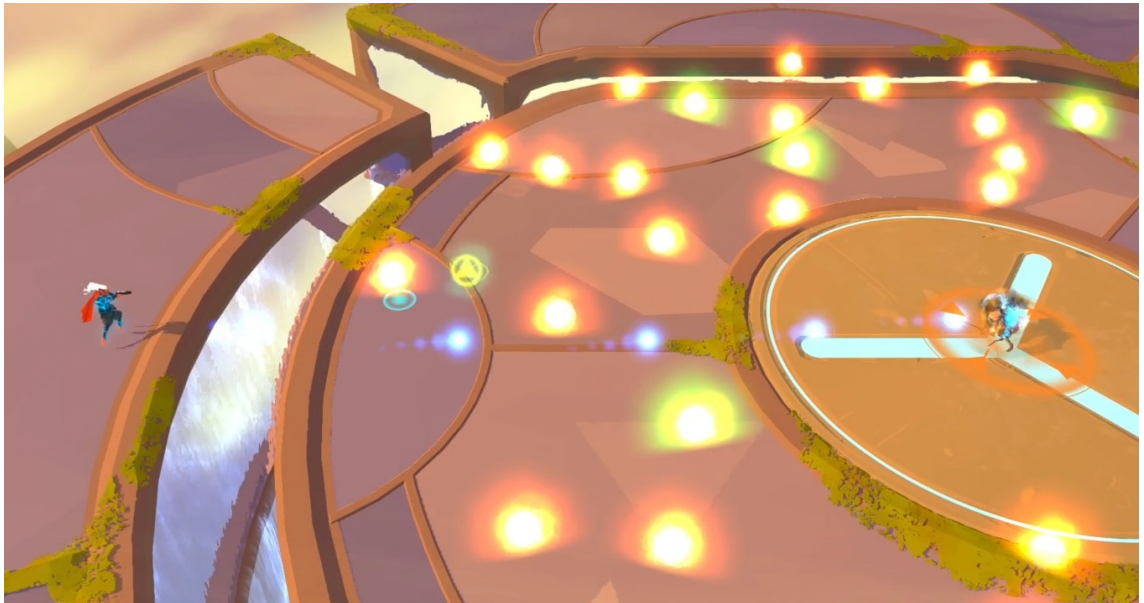
PICTURE 9. Health display in Furi.

What makes the combat in Furi stand out is its fast pacing, wide variety of enemy attack patterns and precise inputs needed to succeed. The parry mechanic is done by pressing a button when a sound plays and enemy weapon flashes white, as seen in Picture 10. Each boss has different timings for the parries and sometimes it's possible to even reflect projectiles. If done successfully, a small amount of HP is recovered, and a stacking damage buff is gained.



PICTURE 10. Parrying in Furi.

Switching between attack styles is an important part of the game. Melee generally deals much higher damage whereas ranged can be used as a filler or for clearing enemy projectiles. If a green projectile is broken, it will drop a health orb that will recover a bar of HP (Picture 11). Some bosses are designed in a way that using a specific style is very hard if not impossible. For example, they could fly outside of the arena forcing the player to shoot them or reflect projectiles while shielded.



PICTURE 11. Ranged combat and health orbs in Furi.

The difficulty of Furi comes from learning the various attack patterns bosses have and reacting correctly. There are 3 difficulty modes, easiest one not giving any in-game achievements. 2nd difficulty is considered the normal experience with achievements unlocked. 3rd difficulty level unlocks when player clears the 2nd one. The fights themselves do allow some mistakes, giving player 3 lives and an extra one every time boss changes patterns if a life is lost. When all lives are gone and the fight is restarted, it begins immediately with no extra delay.

3.4.2 The Textorcist: The Story of Ray Bibbia

Released in February 2019 and gaining around 200 000 steam purchases to this date with 83% of them being positive, Textorcist is a niche game targeting bullet hell fans. It has the most unique gameplay of all the games in this thesis, with all

its interactions and fighting done by typing words. While game critics praise the game for being unique and well executed, players who leave negative reviews mention how the movement and typing doesn't feel great when done together.

Like Furi, Textorcist consists of multiple boss fights with some story in between the fights. Player moves around by default using Shift + WASD and types the letters when not holding Shift. This generates some issues with accidental key presses due to constant moving to dodge projectiles and having to type fast for dealing damage (Picture 12). Failing to type a letter resets the combo meter which is used to determine how high score the player will earn.



PICTURE 12. Boss fight in The Textorcist.

Player can get hit as many times as they want to. On first hit the character will drop his book nearby and player must move towards it to pick it up and continue typing. If they fail to pick up the book before getting hit again, a life is lost. When all lives are depleted, the fight fails, and it must be replayed from beginning. There are ways to make fights easier or harder by equipping certain items which in return either decreases or increases the points gained. These points are used to determine players rank on online leaderboards.

3.4.3 Magicka

Magicka is an action-adventure game released in January 2011 focused around experimenting with various spells formed from combining different elements. Overall reception of the game has been good with around 89% of player review being positive with most praising how fun the game is, especially when played in co-op. The negative reviews mostly revolve around bugs and crashes the game has.

The game has multiple gameplay modes including an adventure mode, PvP, challenges and DLCs. All of these can be played in co-op with other players. Before starting a game session, player can select which wizard they want to play changing some functionality such as having different starting weapons or robes that make certain elements heal or damage the player.

Combat in Magicka uses an element system. Player can select up to 5 different elements from available elements: water, life, shield, ice, electricity, arcane, rock and fire. Some of the elements cancel each other out, such as ice and fire. Others combine into a completely new element, water and fire creating steam. After the elements have been selected, they can be used for launching a spell (Picture 13). Each combination produces a different result leading to hundreds of different possibilities. Some predetermined spells have specific combinations used to casting them adding more complex combinations in game such as summoning rain and then using electricity on enemies while they are vulnerable.



PICTURE 13. Spell to cast life-enchanting rocks that heal when destroyed.

What makes this combat system shine is its unpredictability and volatile nature. This is further amplified in co-op mode where each player is doing their own thing resulting in crazy chain reactions often killing the players in process. Having access to revive spell, heals and barriers can mitigate most of them. This leads to one of the pain points of single player mode since self-healing is reduced compared to healing allies and accidental deaths can be much more frustrating since player has to start either from beginning of the map or from previous checkpoint.



PICTURE 14. Electricity and water beams about to collide and explode.

3.4.4 Comparing features

The selected games for this section are quite different from each other. Their closest similarities are boss fights, movement, and bullet hell aspects. Furi and Textorcist are the fastest paced games out of these three with Magicka giving the player a bit more time to think for best solutions. Each of the games is punishing when making mistakes, sometimes leading to immediate death.

TABLE 3. Feature comparison

	Furi	The Textorcist	Magicka
Difficulties	Three	One	One
Upgrades	No	Powerups & handicaps	Equipment
Combat style	Melee & ranged	Typing	Spells
Health	Amount & lives	Lives	Amount
Difficulty	Hard	Challenging	Casual
Out-of-level progression	No	No	No

3.4.5 Unique features

Furi and Textorcist are like each other with their focus being on beating challenging bosses. Magicka focuses more on giving the player a fun experience with its references, storytelling, and elemental reaction-based combat. The following features make these games stand out from each other.

Furi, while being praised for its challenging fights, has quite simple controls designed for a controller. What makes it shine is:

- Clear phases in boss fights with progressively harder mechanics
- Parry mechanic that feels rewarding by healing and buffing the player
- Very fast to get back in fight after dying

The Textorcist is a bit less punishing than Furi with its bible mechanic that provides the player a chance to recover from mistakes. What makes it stand out is:

- Typing integrated in every aspect of the game, including combat

- Allowing player to adjust the difficulty by equipping various items while affecting their score gains
- Lives only being lost if the bible is dropped and not picked up before getting hit again

Magicka uses a unique element-based combat that isn't seen in any other game covered in this thesis. What's unique about the games is:

- Element storing system that lets player queue the elements and cast the spells with their desired combinations
- Elemental reactions which create interesting combinations in multiplayer
- Equipment changing which element heals or damages the player, for example some robes changing healing from life to electric

4 DESIGNING A COMBAT SYSTEM

4.1 What is Ripple in Dimensions?

Ripple in Dimensions (RiD in short) is a game that I have been working on myself during my studies. It's still relatively early on its development so this is a perfect time to design a proper combat system for it. The game is in 3D and was originally planned to be in bullet hell genre. There was some prototyping done with various ways to control the character and the result of these was to go with a static camera from above in a slightly tilted angle to get a better view of the playing area.

4.1.1 Core design pillars

The goal of this game is to provide an enjoyable and challenging playing experience. It should be tuned in a way that failure is common and getting past obstacles feels rewarding. The target platform is PC, but features should be designed in a way that they aren't too complex for other platforms. The most important part is to get the movement and combat to feel great to play.

4.1.2 Limitations

Because the game is designed with multiplatform in mind, controls should be relatively simple. Having a static camera can cause some issues identifying objects that are below each other which should be kept in mind during design process. 3D can also cause extra performance strain on the device when the number of objects in playing field increases. The game is created in Unity which leads to the programming language being C#.

4.2 Choosing suitable mechanics

Bullet hell games generally have 2 things consistent between them: a player character and enemies that shoot projectiles. The gameplay experience revolves around the player dodging those bullets while dealing damage to defeat the enemies. Since games are flexible, these said elements can be bent drastically while still retaining the same structure. For example, *The Textorcist* replaces the generic damage dealing aspect by typing words, providing player a fresh perspective to established genre.

The original plan for *RiD* was to use very similar mechanics present in *Touhou* games. However, after analysing popularity of similar games, it became obvious that games that copy *Touhou* aren't popular outside of that game series. The series has barely changed in a decade, with the core mechanics intact from end of arcade era. Some features such as scoring system and continues feel outdated in today's gaming landscape.

With that in mind, *RiD* can take away some elements from traditional bullet hell games. Having one player-controlled character seems to be a constant in every game across this genre. If the goal is to dodge projectiles, having multiple characters on field at the same time might be difficult to both implement and perceive for players. Another constant feature of bullet hell games are the enemies being the source of projectiles. Defeating the enemy means defeating the source, usually making the fights easier and diversifying the gameplay experience by creating a target priority system for player.

With the basic gameplay selected to be a player character defeating enemies while dodging projectiles shot towards them, the design challenge lies upon making the experience unique and interesting. Basic tools for adjusting this experience are attack styles, health values, movement, and enemy behaviour. Additional things to consider could be difficulty, powerups, progression, and resources.

4.2.1 Attack style

The first and possibly most impactful thing to consider is how player performs the attacks. Games covered in this thesis all have different takes on this subject, some of them being passive and others requiring precise timings to succeed. The older, arcade-era Shoot 'Em Up and early bullet hell games use a basic attack style, where holding down a button fires a stream of projectiles in front of the player. The issue with this system is the lack of player interaction. It quickly becomes just an extra button that must be always held down during gameplay, which leads to a question: why does it even exist?

Enter the Gungeon managed to solve the problem of pointless shooting by limiting the amount of bullets player has. The positive side of this is that it leads players to experiment with weapons they might otherwise not use when their old ones run out of ammo. Vampire Survivors completely automated the shooting process and focuses more on giving the player choices on which weapon they prefer upgrading. Furi has infinite ammo on ranged weapons but handicaps using them by having enemy AI react to player staying far away and balancing the damage dealt to favour melee weapon. Magicka uses a system that lets player buffer their inputs and choose the time of attack when it's favourable. The Textorcist completely removes the need of attacking since the fight end when player finishes typing all the words.

It's difficult to determine what styles is the best. What's important is that it feels good to play and doesn't frustrate players. For bullet hell games, the player attention generally is at the enemy projectiles so providing a simple attacking style has the benefit of letting player focus more on surviving. While Textorcist has an interesting take on combat, it is heavily criticized for its difficulty and unintuitive gameplay.

What bullet hell games in general are lacking is the feeling of impact in player attacks. Furi did a great job making each hit important by utilizing invulnerabilities in boss attack patterns and generally balancing the attacks to deal high damage when done properly. Magicka is another great example of having very powerful elemental combinations that drastically alter the power of spells used. Since RiD

is fundamentally designed as a multi-platform title, creating a very complex attack style such as the ones used in Textorcist requiring a keyboard or Magicka having 8 different elements (Picture 13) is not possible. However, the idea of buffering attacks and timing when to use them is a very interesting concept. The challenge for this is to make the attacking interesting and intuitive to use. Magicka's element system could be streamlined to 2 or 3 colours with each having different effect on enemies and their projectiles.

4.2.2 Health

Games analysed in this thesis had 2 different styles for managing health: lives and amount. Some of the games utilized a system that included both, lives being lost when health goes to 0. Touhou is the most punishing game on the list with any hit taken from enemy bullet killing the player character and losing a life. This system is generally not used in today's games due to its frustrating nature, usually feeling unfair. Textorcist enhanced this system by giving a grace period for player after getting hit. The character drops his book, preventing attacking until it's picked back up. Losing the book from first hit doesn't reduce lives, getting hit while the book is dropped does. This gives the player a chance to recover from mistakes and leads to more enjoyable gameplay experience.

Out of the analysed games, Magicka felt the most unfair, especially when played alone. The games volatile elemental reactions can easily lead the player instantly dying with little to no counterplay. All the multiplayer games used amount system rather than lives, usually allowing the player to heal themselves. Furi utilizes both, amount being healed during fights by picking health orbs and parrying with lives healing when transitioning to next boss phase.

When it comes to choosing between amount or lives, amount generally feels better for games that have unavoidable damage or when wanting to design attacks that deal different amounts of damage. Amount also has the added benefit of easily displaying values such as health regeneration or damage over time effects. Lives in other hand can feel more punishing but also more rewarding. Getting an extra life usually feels better than healing 40 health. With that in mind, lives seem

to be a more logical choice for a bullet hell game. Giving the player a second chance before losing one is important to mitigate frustration.

4.2.3 Movement

Moving around is a crucial part of bullet hell gameplay. The whole genre revolves around surviving enemy bullets so giving the player tools to do that is important. Touhou has very basic movement with character moving around by pressing arrow keys with shift being a slow-down mode for precision movement. Enter the Gungeon moves with WASD and lets player dodge roll with iframes. Furi is recommended to play with controller due to the need of directional aiming but can be controlled with keyboard.

With multiplatform in mind, having a toggleable slow-down mode and basic directional controls is doable on any device. Since RiD is a 3D game, it can greatly benefit from features such as utilizing height axis by providing a player an ability to jump or float. Out of all the analysed games, Furi was the only one with any depth and even that was limited to falling when running off the edge of play area. Dash or dodge roll can also be very beneficial for player if designed well, however these might cause more harm than good if the player is required to do complex combinations of jumping and dashing at the same time, especially on devices such as mobile.

4.2.4 Enemy behavior

There is one thing that anyone who has played bullet hell games before hates and its random projectiles. Games from this genre revolve around challenging boss fights and part of the enjoyment comes from learning them, being able to beat the fights without taking any hits. This raises an interesting question: is there a reason to have other enemies than bosses in the game?

Touhou, Vampire Survivors, Loop Hero and Enter the Gungeon all follow similar structure. A level has waves or rooms of enemies with a boss in the end. This

gives the player time to collect powerups and weapons, increasing their chances of defeating the boss. Furi and Textorcist in other hand only have boss fights in them with a short story sequence in between the battles.

In roguelike games the filler content between bosses plays a big role due to the nature of powerups varying between each game session. In games where the focus is more on playing well and learning the fights, the importance of these filler fights is reduced. They might even be detrimental to the gameplay experience if not balanced well, being more difficult than some boss fights.

For RiD, the most logical solution would be to only focus on boss fights. This is partly due to limited resources when developing the game and being able to focus on what is most important to the players. Furi is the best example of well-done boss fights out of the analysed games. Each fight consisting of multiple phases with progressive difficulty, earlier phases introducing simple mechanics and later phases combining those to complex patterns. Another thing Furi boss fights utilize well compared to other bullet hell games is the environmental impact. Some of the fights use things like walls or holes to add depth into the gameplay.

4.2.5 Additional mechanics

Most common concern players have while speaking of bullet hell genre is the difficulty. While some games offer players multiple difficulty options to choose from, this might not be the best way to handle it. Out of the analysed games, Furi and Touhou were the only ones offering multiple difficulty levels for players. Other games had the possibility of making the playing experience easier either by getting lucky or selecting specific power ups. In general, the issue with difficulty levels comes from players having vastly different skill levels. Someone who can easily beat easy difficulty might struggle in normal and someone who beats normal doesn't even want to try hard.

While difficulty levels might be easier to implement by simple doubling numbers or changing some patterns, a gradual difficulty curve provided by player choice seems like a better way of handling it. Textorcist did a great job allowing player

to either increase the difficulty by taking handicaps such as slower movement speed in return of gaining more points or reducing the difficulty while losing points. The challenge with this kind of system is the reliance on reward system. Textorcist has global leaderboards with score rankings pushing the players to achieving the highest score possible.

The reliance on reward system is tied with progression and resources. In RiD, the progression will be based on bosses defeated. The current plan for progression structure is to have several boss fights to choose from. After defeating the first boss, player unlocks a choice of 2 more, each leading to more fights. This can later be expanded by adding more fights as a separate entity. When it comes to resources, a score system seems outdated. For a single player game, a system where rewards are unlocked based on progression or achievements feels more rewarding. This could include features such as unlocking more playable characters based on which bosses are previously defeated or giving the player rewards for clearing certain phases.

4.2.6 Summary

The game is going to be a traditional bullet hell game in a sense that it uses isometric camera, has a player character, and bosses that shoot projectiles. If a projectile hits a player, a short period of invulnerability occurs, and the player drops a soul. If the soul is picked up before getting hit again, they don't lose a life. Each boss fight starts with 3 lives and losing all lives forces the player to restart the fight.

Player moves with WASD keys, Shift toggles slow mode allowing precise movement and spacebar is used for jumping. Some environmental objects such as rocks can be used to elevate player for longer periods allowing for more complex 3D attack patterns. Q and E buttons can be used to dash sideways with a short cooldown period attached to them.

Attacking is done by buffering 3 colours using arrow keys. Left, down and right arrows assign a colour to the buffer and up arrow launches the attack. Attacks

can be performed with less than 3 colours in them which leads to a lower amount of damage dealt. The colour of attack can be utilized to make fights more interesting by giving the enemy certain phases where different colours must be used, making the players modify their combat tactics. It could also be possible to modify the effects of the colour combinations with out-of-game progression, such as powerups or additional characters.

4.3 Implementation challenges

The game being in 3D can be a great benefit but also a detriment. Most of the games in bullet hell genre are in 2D, most likely due to the genre born during arcade era. While 3D offers another dimension with height being available, it does pose some challenges that should be considered during development. From early testing, multi-layer attacks can be very difficult to visually perceive when using isometric camera. This is due to certain bullets, depending on their size and colour, blending under others making them very difficult if not impossible to see.

Performance is another impacting factor. Rendering hundreds of 3D projectiles can be taxing for devices and the engine. There are some workarounds for this, mainly following a good art pipeline to keep the asset sizes small and understanding how Unity handles creation and deletion of game objects. From early testing, the biggest performance loss came from creating multiple objects on same frame.

Visual clarity is important. Keeping the colours and shapes clear can make a huge difference in playing experience when some of the movement decisions happen in split seconds. Player attacks should be made in a way that doesn't hide enemy projectiles and the character should be clearly visible. Projectiles should not blend with the background colours. UI design should be done in a way that doesn't hide important aspects of the game under it.

4.4 Implementation roadmap

This section describes a possible roadmap for implementing the features in an order that makes sure the game is in a playable state as soon as possible. Since this thesis is about designing a combat system, only the relevant production phases are listed. The result should lead to a product that can further be developed without having to worry about altering core mechanics.

To get the game in a playable state, it needs a player character and an enemy. The enemy should be able to shoot projectiles that deal damage to the player when colliding with its hitbox. When the player runs out of lives, the fight should restart. At this phase, the enemy can be static and have a pattern that repeats every few seconds. The player should be able to move around using WASD keys and shoot projectile using up arrow.

The next phase is to finish player movement. Slow-down effect should be added on player movement and arrow keys added to the attack pattern with each key giving different colour on projectile. Player should be able to jump and use side-ways dashes. When getting hit, the player should gain short invulnerability period and drop a soul in a random position short distance away from them. If the player gets hit while soul is dropped, a life should be reduced, and the soul recovered. Soul should be recoverable by walking on top of it.

After the player character features are finished, the enemy AI is next. Enemies should have a health bar displaying the current amount of health and hitting them with an attack should reduce the health. When the health bar is depleted, a new phase should begin with different attack patterns. Initially the attack patterns can be simple, but they should be different in each phase. The number of lives should be displayed for the enemy with the amount based on how many phases the boss has.

When the player and first boss are finished, the core gameplay should be ready. Further expansion of features requires UI work, such as adding level selection, powerups and tutorials. Additional boss fights can be worked on by using the first boss as a base and adding more attack patterns.

5 DISCUSSION

Having been part of developing multiple game projects but never sitting down and designing something from scratch, this thesis gave a great opportunity to get past the block that I have had with RiD project. I had felt like there was something fundamentally wrong with the project, so its progress has been slow. Now, after analysing multiple games from various genres, I got a much better understanding of what is going on with them and how to implement new features to enhance the gameplay experience.

While some of the games picked for analysis might not seem relevant and didn't get much time during the design part, they served as an important reference point when it comes to applying mechanics from similar genres. The auto battler genre fundamentally didn't work with bullet hell due to the nature of requiring active input, but they did have other supporting mechanics that could provide useful when designing the resources in future.

This research led to a solid framework on how to continue building the RiD project and forms a core gameplay loop. Some of the proposed features might require tuning after being able to test them but I'm fairly convinced that most of the rough parts can be easily fixed by changing values. The genre itself is proven to work, although targeted to niche audience so if this project is ever finished, it can't be expected to become a mainstream success.

Since the game mechanics are usually determined good or bad in individual basis based on persons feelings, it's difficult to outline a best combination. If this thesis topic were to be further researched, a user study could be implemented where the participants are given various game mechanics to test, and those results could be used to form more precise answer. Having a larger sample size of games could also be used to further find similarities between games and what makes them work.

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