Automated Camera Control for 3rd View Video Games

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MInf Project (Part 1) Report
Master of Informatics
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2024

Abstract

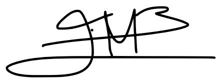
Third-view cameras in video games have been a topic of ongoing development. Nevertheless, we discovered that issues have risen within automated tools, designed to aid players when controlling the camera. This is the case of the target-locking system, which aims to release the player from handling the camera by automatically focusing on the nearest enemy. However, it causes frustration when dealing with multiple enemies, as it does not select the best option in many scenarios. To overcome this issue, we implemented four new systems based on different game metrics, such as health, threat level or weapon type, to discover whether the standard locking can be outperformed. Our study reveals that players prefer a dynamic approach, where the target is switched automatically as the fight develops to update the most significant threat. These findings prove that the standard system is too simplistic and that changes are necessary to enhance the player's experience.

Research Ethics Approval

This project obtained approval from the Informatics Research Ethics Committee.
Ethics application number: 750126
Date when approval was obtained: 2023-12-15
The participants' information sheet and a consent form are included in the appendix.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.



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Acknowledgements

I would like to thank my supervisor Dr. Steve Tonneau, for his guidance and support throughout my project. I am very grateful for the opportunity he provided me to embark on the world of video game development, which I have found very engaging and gratifying.

I would also like to thank my friends and family, for their continuous support and advice through this very long year! This would not have been possible without your help and encouragement.

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Chapter 1

Introduction

1.1 Motivation

The video game industry has been an area of continuous advancement, captivating millions of players around the globe. As the complexity of these games has grown substantially, so have the challenges players encounter during their gameplay.

Video games are tested in order to improve their usability and uncover issues like bugs and glitches within the game experience (Varvaressos et al., 2017). These include graphical errors, collision detection problems, and other unexpected behaviours, which can result from errors within the game's code. However, in many cases, they can also be a consequence of poor computer performance. These issues have been researched extensively through time using Machine Learning techniques such as Deep Convolutional Networks to detect them (Ling et al., 2020) or other automated tools (Varvaressos et al., 2017). Nonetheless, there is still room for improvement in numerous problems that are not as trivial to the eye.

Specifically, cameras in third-view video games have been the subject of criticism due to the difficulties they can produce. The most known issues are the collisions and occlusions of the camera, which have been a topic of research (Haigh-Hutchinson, 2009). Nevertheless, other problems that impact the player's immersion in the game and affect their gameplay have not been addressed. Especially, issues that are related to fast-paced scenarios directly influence the player's experience, leading to frustration. During fighting scenes, where decisions must be made instantaneously, less experienced video gamers use tools to aid them in targeting the enemies to create a more enjoyable experience. This is known as the lock-on feature, which makes the camera follow the enemy to facilitate the attacks from the player. However, when multiple targets are in sight, the camera will not choose the optimal opponent. The elimination of the optimal enemy will guarantee better chances of survival or major total damage done; thus, not choosing the enemy that poses the most significant threat can sabotage the combat and lead to the player's discouragement (rev, 2020).

The conventional locking system involves choosing the enemy closest to the player or their crosshair icon (Vicencio-Moreira et al., 2014) (Bateman et al., 2011). This approach could make the player vulnerable to attacks from other enemies that the system did not consider. In response, the public has described their experiences and the frustration behind the current target-locking.

Therefore, we created new target-locking systems, each focusing on different fight features, to identify a solution that meets the players' needs and makes the experience more enjoyable.

1.2 Research Objectives

The main objectives that this dissertation aims to complete are the following:

- **Understand** current target-locking systems and their issues.
- **Investigate** whether the standard distance-based target-locking system is under-performing, given the complexity of abilities and enemies in games nowadays. Merely choosing the closest enemy might not be the most effective strategy.
- **Create** new systems that focus on different features to test whether there exists a solution that generates less frustration for players.
- **Develop** an environment to test the different target-locking systems.
- **Test** the locking systems with participants who have different experience levels with video games.
- **Analyse** the results from the experiments to find the locking system that gave the best experience to the players.
- **Draw conclusions** regarding the drawbacks and benefits of each system, and describe potential improvements for the future.

1.3 Contributions and Limitations

Our research on third-person camera problems unveiled that automated tools, like target-locking, can cause issues within fights by selecting enemies that the players do not consider relevant. It consists of a problem that has not been addressed, although it has been demonstrated that it causes dissatisfaction and frustration. Hence, we focused on the implementation of new systems to overcome the issue at hand.

Through the implementation of a baseline scenario with three different enemies, we created an environment where different target-locking systems could be tested on equal footing. For this project, we implemented the standard system used in video games and developed four new ones:

- A **health-based system** which prioritises enemies with the lowest health.
- An **extension of the standard system**, which initially selects the closest target but will switch to the subsequent closest enemy if not eliminated within five seconds.

- A **threat-based system** that selects the target that has conducted the most amount of damage.
- A **weapon-based system** which selects the enemy most vulnerable to the currently chosen weapon.

It is important to note that the health-based system is the only static approach among all, while the others exhibit dynamic behaviours. This means they can automatically switch between targets depending on each system's constraints, ensuring a fluid and responsive experience.

Following the testing of eighteen participants, we concluded that the standard distance locking failed to meet their expectations. In contrast, the weapon-based and threat-based systems gave the best results, favouring the dynamic nature of these approaches. The distance-switching method showed limitations since players felt they lost control when it suddenly changed the target. The remaining static systems were described as simple, as they did not contribute positively to the fight.

This initial study serves as a starting point, offering insights into the preferences of players with different skills and experiences. However, it should be noted that the eighteen participants do not dictate the absolute truth about the most favourable target-locking for video games. A larger and more diverse sample size would provide a more comprehensive understanding and more accurate conclusions.

1.4 Structure Overview

Before answering the proposed research objectives, it is essential to provide a brief overview of the existing literature regarding target-locking systems in third-view video games, given in **Chapter 2**. However, it is not a subject that has been thoroughly treated in the past, so we give more importance to the following chapters.

In **Chapter 3**, we describe how the game environment was implemented and justify the main design decisions, which are meant to emphasise the target-locking systems. We illustrate how the game is organised to inform the reader of how users will engage with it in the testing process.

Then, once the baseline has been drawn, **Chapter 4** explains the implementation of the standard target-locking system, as well as the new ones we designed and their respective justifications. We also outline the procedure to test each mechanism and how we can extract meaningful data from the scenes.

Upon completion of user testing, we can present the findings in **Chapter 5** and analyse how each system performed. These results are further discussed in **Chapter 6**, where we describe the limitations and reflect on potential improvements. Finally, in **Chapter 7**, we conclude the dissertation and summarise the key findings, giving an overview of the outcomes of the study.

Chapter 2

Background

A running problem throughout multiple video games involves camera displacement. As of today, the most common camera models involve first and third-person views (Naftis et al., 2021). By using a first-person perspective, players can live the experience from the eyes of the main character, making the adventure more immersive. Its principal disadvantage is that it has a minimal view, meaning there is a restrictive field of view where the spatial relationship between the main character and in-game objects is more difficult to acknowledge (Haigh-Hutchinson, 2009).

As a result, third-view video games have become more successful with time and are now the preferred camera model by game developers, especially for role-playing games (RPGs) (Naftis et al., 2021). Here, the camera is separated from the main character, and, as a result, the disadvantage of the first-person view is overcome. The player now has a wider field of view, offering a perspective of the character itself and its surroundings. However, from a game design perspective, more issues arise as the player now has to operate the camera separately from the character.

Nevertheless, having such freedom when using the camera can also produce issues within the gameplay, which are explained in Section 2.1, for general context. Moreover, there are other problems that emerge from this freedom that are not a result of the game's implementation. In fast-paced environments, players have little time to make big decisions, and the control of such a camera is considered an additional stress. Consequently, the idea of targeting assistance tools has been introduced to video games in order to relieve the player's frustration, which we explained in Section 2.2. Then, we focus on the issues that emerge when employing this tool, especially the lock-on feature. It is an important problem that affects the players' experience, and since it has not been explored, we aim to formalise this concern in Section 2.3.

2.1 Previous Work on Third-View Camera Problems

Third-person view in video games involves making a free-form camera move correctly through a dynamically changing scenery, while simultaneously avoiding collision with the environment. Thus, obstructions and occlusions are some of the most discussed problems involving cameras, as they produce a view blockage by characters or other objects. Numerous of these issues arise from the unexpectedness of the player's actions. As the camera is allowed to move freely by the human component of the game, there are many behaviours game developers are not able to predict, leading to circumstances where the player cannot see elements of importance or obstacles, generating player frustration (Haigh-Hutchinson, 2009). Since it is an issue that is discussed recurrently, many working collision detection strategies have been proposed.

One of the most common solutions to avoid the blockage of the scenery is to use hitboxes, which consist of bounding boxes that, when intersected, will recognise a hit (Lazaridis et al., 2021). Although making the geometry simple makes the approach less accurate, it makes it less computationally expensive. Another well-known approach is to use ray casting techniques. This consists of a mathematical projection of a straight line through the environment, which then determines if the line intersects with any type of geometry. Consequently, the game will be able to anticipate when a collision may occur and change the camera's motion accordingly (Bikker, 2007). A downside of this approach is its performance requirements; complex environments will require an increase in rays which can be very computationally expensive. To resolve this issue, many games have adopted volume projection, specifically spheres and cylinders (Haigh-Hutchinson, 2009). The third most known resolution used to avoid collisions with the camera is known as object repulsion. In this case, objects in the game will actively evade the camera (Haigh-Hutchinson, 2009). However, if many objects within the scene are altering their path, it may become evident to the player.

It is, therefore, an area where considerable investigation has been carried out, taking into account constraints, like the player's randomness regarding their actions, and proposing solutions accordingly. Nonetheless, some problems do not concern the game's implementation per se but the gameplay itself. More prominent issues can emerge in certain scenarios where the player's movements are even more unpredictable. Especially during combat scenes, which involve a fast-paced environment where rapid and strategic decisions have to be made. This can be a challenge for less experienced players, which is why many tools have been implemented to make the experience more enjoyable, such as the target assistance methods.

2.2 Targeting Assistance

Before delving into the camera lock-on feature and its issues, it is important to explain what targeting assistance is and why it is a necessary component. For those games where fighting and aiming are involved, different assistance techniques have been implemented to aid in targeting enemies more efficiently and accurately, especially for those who are still developing their skills. Common techniques employed in shooting games include area cursors, target gravity or sticky targets. Area cursors will increase the size of the target icon and will select the enemy that touches any region of the icon (Kabbash and Buxton, 1995). On the other hand, Target gravity will subtly motion the player towards the enemy, taking a part of control away (Bateman et al., 2009). Lastly, sticky targets will change the relationship between the input device (a mouse or controller) and the cursor seen in the game (Blanch et al., 2004); the player will have to move the pointing device a larger distance to achieve the same amount of cursor movement, allowing more precise movements.

Research has shown that these techniques are useful to engage those players who have different skill levels, especially in competitive video games (Bateman et al., 2011). This is particularly true for those games where a skill balance is necessary to advance. It was proven that, generally, targeting assistance gave better results for the players with lower skills, extending their survival and increasing the total damage done. It is, therefore, an important tool within video games, especially for those who have just started playing. In the competitive environment, it would allow people with different experiences to play together, allowing novice players not to get frustrated and have more fun without hijacking the gameplay of experienced players.

These three tactics are seen a lot in first-person shooters, where players expect a degree of control over their targeting without sacrificing the challenge and making it too easy. In contrast, third-person perspective RPG games like the *Zelda* franchise, *Grand Theft Auto* or *Red Dead Redemption* use a different approach (Vicencio-Moreira et al., 2014). The system automatically directs the player's aim towards the enemy, making combat more manageable for those who prefer to focus on the storyline or the exploration aspects of the game. This technique is known as the lock-on feature; however, it can also create frustration in certain scenarios.

2.3 Camera Lock-On Feature

In 3D action games which have free control of the camera, inexperienced players may need a method to focus on the object of interest, especially during fights. This way, the player will not have to deal with attacks and the camera simultaneously, which can be frustrating for those with fewer skills. To indicate the enemy that was selected, an icon usually wraps the enemy, as seen in Figure 2.1, aiding the player to quickly identify their target without wasting time searching for it.

Figure 2.1: Targeting system in *The Legend of Zelda: Ocarina of Time*. Image obtained from (zel, 2018).

Presently, different types of lock-on systems exist. For instance, the hard lock-on is used where precise aiming is essential. Here, when the system is activated, the camera will lock into the nearest target until deselected (Wagar, 2020). In contrast, the soft lock is known for having some degree of freedom; the camera will target the nearest or the selected target, but the player will be capable of moving the camera to some extent (Wagar, 2020).

In relevant studies, it has been proven that it is a useful feature not only for RPG games but also for first-person shooter games which involve competitive play (Vicencio-Moreira et al., 2014). Novice players struggle to succeed in these complex environments, where they have to move, select targets and aim simultaneously. It has been shown that the lock-on feature gave the most objective difference between different target assistance techniques, resulting in higher accuracy and reducing mortality rates.

However, although it can give good results, many problems arise when more than one enemy is in sight. Since the enemy closest to the player or its crosshair icon is automatically selected, the best choice given the specific scenario may not be targeted.

2.3.1 Lock-on Problem

When there are multiple enemies in sight, the camera may lock into the unintended target or even the less optimal enemy. An example of this behaviour can be seen in Figure 2.2. This can result in an event where the player receives more damage than premeditated and may need to reset the scene. From players' reviews, it is evident that it is a problem that affects their experience. For instance, the *Dark Souls* franchise has received numerous critiques for its lock-on tool. If it is employed when multiple enemies are in sight, the selected target changes sporadically through the fight (rev, 2020) (rev, 2014) (rev, 2011).

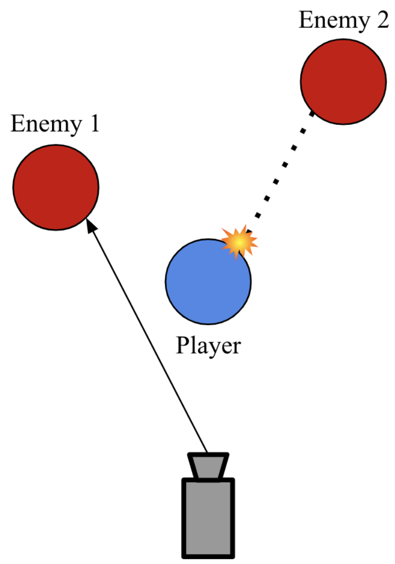

Figure 2.2: An example of the lock-on problem. Even though Enemy 2 is inflicting damage on the Player, the camera focuses on Enemy 1 due to closeness.

Research has been done to optimise certain factors of target selection. For instance, it has been shown that manually selecting the target the user wants to focus on can be a challenge, especially when it involves an enemy in constant movement. Papers have proposed different techniques to solve these issues (Hasan et al., 2011). However, the creation of a system which selects the best targeting choice when the lock-on feature is activated has not been touched upon greatly.

Although the soft lock-on mechanism can help manage multiple enemies, as the player can gravitate towards different targets, it does not solve the issue of selecting the enemy that could guarantee the best outcome, which can sabotage the player's experience.

Other resolutions consist of utilising the Borda count method (Uriarte and Ontanón, 2015), which was used to rank the preference for targeting different enemies during combat. It keeps track of the order in which the different types of enemies were eliminated by assigning points: if eliminated earlier, more points it will receive. Then, to determine the ideal preference after analysing multiple combats, the average is taken, providing a numerical representation of the best order the enemies should targeted on. However, this approach treats all enemies equally, which can be unfavourable in certain situations where there are stronger enemies than others. In addition, ties are not handled, and different methods to break these ties could lead to many different results that might not guarantee the survival of the player. Since this method can lead to inconveniences when multiple enemies are involved, other outlooks should be considered. No relevant research on this specific topic exists; therefore, it is a new territory we have to explore and develop.

2.4 Summary

The video game industry has undergone significant advancements over time, leading to the generation of new challenges the players have to face. A persistent issue in games involves camera displacement, especially when considering third-person perspectives.

In combat scenarios, where fast-paced decision-making has to be made, less experienced players can make the experience more enjoyable when using automated tools to help them advance. In particular, the lock-on feature will allow them to automatically select a target and follow it with the camera. However, when multiple enemies are involved, it is a common problem that the camera does not focus on the target of most interest. Even though games have become more complex with time, the target-locking system has not evolved. Therefore, by implementing different systems which take into consideration other features apart from distance, the issue could be potentially resolved.

Chapter 3

Designing the Game Environment

To evaluate different target-locking systems, we created an appropriate scene to analyse them. To develop this scene, we used the game engine Unity (Haas, 2014), which offers advantages, particularly for those new to game development, since it provides comprehensive documentation and resources which can make the process more accessible. The Unity Asset Store provides pre-built tools to enhance the project, including physics engines which could facilitate realistic movements, collisions and interactions from within the game world (Hussain et al., 2020). Therefore, for this specific project, it made sense to choose this platform in order to take advantage of its 3D and 2D capabilities.

The possibility of modding an existing game was also considered. However, creating a scene from scratch gives distinct advantages, such as having a controlled environment. This allows for customisation, allowing us to tailor it specifically for our testing purposes. Even though modding a game which suffers from target-locking issues would give a more realistic experience and would have spared us the need to design a new environment, it posed several technical limitations. Integrating new systems into an existing game could interfere with the implemented mechanics, affecting the gameplay venture. In addition, the fluidity in testing could have been hindered due to distractions and interruptions from within the game, restraining the participants from using the locking systems.

3.1 Design and Setup

The overall environment consists of a large plane enclosed by walls on each side (materials acquired from SpeedTutor (2020)), as seen in Figure 3.1. Given the primary goal of evaluating different targeting systems, adding obstacles and other objects to the scene would not make any contributions. Consequently, the player can concentrate solely on testing and experiencing the advantages and drawbacks of the different target-locks.

The absence of other objects will also allow us to get a clear focus on the performance of each system in isolation. If an enemy is hidden behind an object, the targeting system will not be able to consider all possible targets and, therefore, will not be tested to its

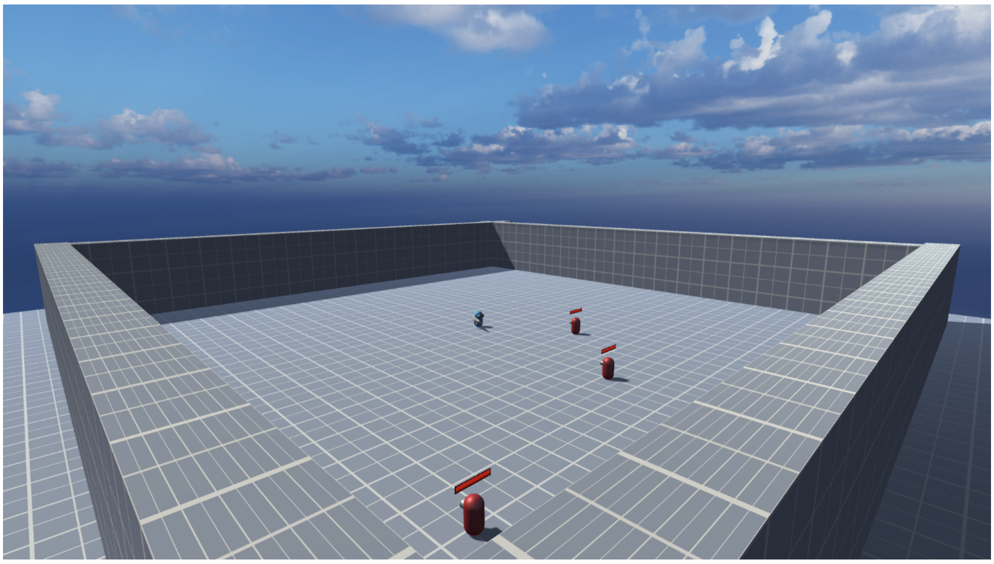

Figure 3.1: Outside view of the overall game environment

full performance. This also ensures consistent testing conditions across all systems and players, from which we can analyse comparable data on how each targeting approach behaves under similar situations.

Additionally, the incorporation of sky elements (material acquired from Whitelock (2021)) and lighting contributes towards the player's immersion, enhancing their overall gaming experience within the context of our investigation.

3.2 Enemies

The general public has described issues and frustration when using target-locking while encountering multiple enemies in a frame. For this reason, we introduced three enemies into the scene, which align with some of the standard opponents found in many video games (Yang, 2023):

1. *Close-range adversary*: positioned nearest to the main player at the start of the game and has the highest health. This enemy will deal the highest damage per attack (20 health points). Despite its great damage, it will exhibit long waiting times between attacks (also known as cooldown) of 5 seconds, which can only be stricken when close to the player.

2. *Long-range adversary*: positioned farthest from the player and presents contrasting features with respect to the first. While dealing less damage (5 health points) and having low health, it compensates with a shorter cooldown, shooting every second from a more significant distance.

3. *Mid-range adversary*: consists of a middle ground between the two extremes, allowing a balanced challenge.

All enemies will engage in random walking until they detect the main player. A new random position is created by generating random x and z coordinates within a specified

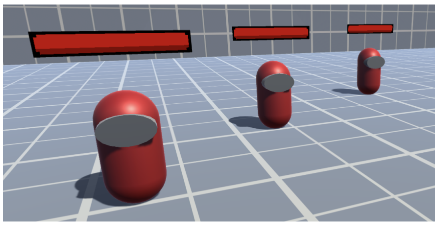

Figure 3.2: The three enemies showcasing full health.

range of 10 world units. This will prevent the players from strategising based on the predictability of the enemies, allowing them to focus on the target-locking itself.

We see their appearance in Figure 3.2. Their minimalist design acquired from St-Amand (2022) allows us to avoid including different animations and focus on the research question. With no animations, we can adapt the different enemies to the parameters of our choice without being concerned about which animation aligns with each scenario. We added a health bar over each opponent in order to keep track of their remaining health, which is also a standard procedure seen among multiple video games (Schell, 2008).

3.3 Main Player and Controls

The main player object is placed in the middle of each scene's environment, providing consistency. We also obtained its appearance from St-Amand (2022), although we employed a blue design to differentiate it from the enemies. To control its velocity and physical properties, we added the Rigidbody component to the game object, enabling us to control its motion under the control of Unity's physics engine.

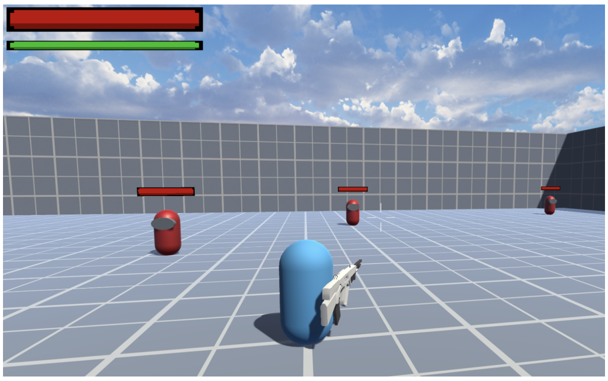

Figure 3.3: The player's point of view, showcasing the health and cooldown bars.

The player can control their movement using the classic `WASD` keyboard buttons as seen in most PC games (Rogers, 2014). With the mouse, they can manually adjust the camera to their liking. Alternatively, they can activate the target-locking function, mapped to the `Tab` key, where the control of the camera is automated and focused on a specific target.

Health status is presented in the top-left corner of the screen, depicted as a red filled-in bar. Below, we encounter a green bar informing the player of the cooldown duration between attacks, as seen in Figure 3.3.

The player will then be able to select the attacks by changing weapons, done by pressing the number keys `1`, `2` and `3`. Every attack will be directed towards the centre of the screen, which is indicated with an aiming icon, informing the player of where they are attacking.

3.3.1 Attacks

The player can choose between three attacks, each providing different characteristics. They all involve shooting weapons, as seen in Figure 3.4 since it makes it simpler for direct customisation. This entails the force and size of the bullets, which directly concern the damage each can inflict. The designs were acquired from Shanshel (2022) and were specifically chosen due to being commonly seen in shooting video games, promoting an intuitive understanding of how they work.

By using firearms, we can customise the range of each weapon. We assigned the Rigidbody component (Goldstone, 2009) to every type of bullet, meaning that each object is under the control of Unity's physics engines. This way, we can modify the drag property of each bullet, which can be interpreted as the amount of air resistance that affects the object, slowing it down. When colliding with the enemy, the bullet will explode to indicate to the player that it was a hit. These special effects were acquired from Technologies (2023). The firearms the player can use consist of the following:

1. *Shotgun*: will deal the most amount of damage to the enemies (20 health points) and has the longest cooldown. It is ideal for close-range encounters since it will lose force as more distance is travelled.
2. *Rifle*: deals the least amount of damage (2 health points) but compensates with the fastest cooldown and maintains consistent force over longer distances. As a result, it can be proven useful for precise, long-distance attacks.
3. *Pistol*: a balance between the previous weapons. Inflicts ten health points of damage and can make attacks every two seconds. Therefore, it results in a good balance as they can deal with a decent amount of damage without having to wait for a longer reloading time associated with the shotgun. It will not, however, cover long distances like the rifle.

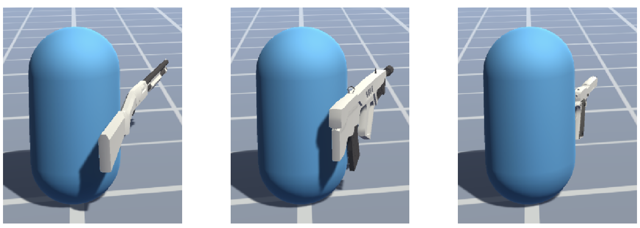

Figure 3.4: The main player equipping the shotgun, the rifle and the pistol, respectively.

We opted for three weapons to mirror the behaviour and features of the enemies explained in Section 3.2. Therefore, by assigning each weapon with a specific combat range, the player can strategise against the enemies positioned at different distances from the player.

3.4 Game Format

The players will first be prompted with a *Main Menu*, where two main buttons are displayed (Figure 3.5). Then, the *How to Play* button redirects them to another scene, showing the game's basic controls, as seen in Figure 3.6. By continuing to the *Instructions* button, they will be able to get a preview of what is to be expected (Figure 3.7). Within the *Main Menu*, the player will have the opportunity to ask further questions on the game mechanics if the written instructions do not clarify any doubts. Then, they can proceed to press the *Play* button.

The gameplay consists of five main rounds, each incorporating a different target-lock system. The scenes do not follow a specific order, so they are placed randomly to eliminate performance biases. Players will potentially adapt to the controls over time, and by placing the scenes at random, we will ensure the best results are seen not only in the last target-lock played.

Before initialising each round, a transition will precede it, explaining the target-locking system they will use next. Figure 3.8 shows an example of this. The explanation will allow the players to use the system to their advantage, giving them time to devise a strategy. In addition, the pause between scenes will also give them the chance to ask questions related to the gameplay.

All fonts used in the transitions and the menu were acquired from Worlds (2019).

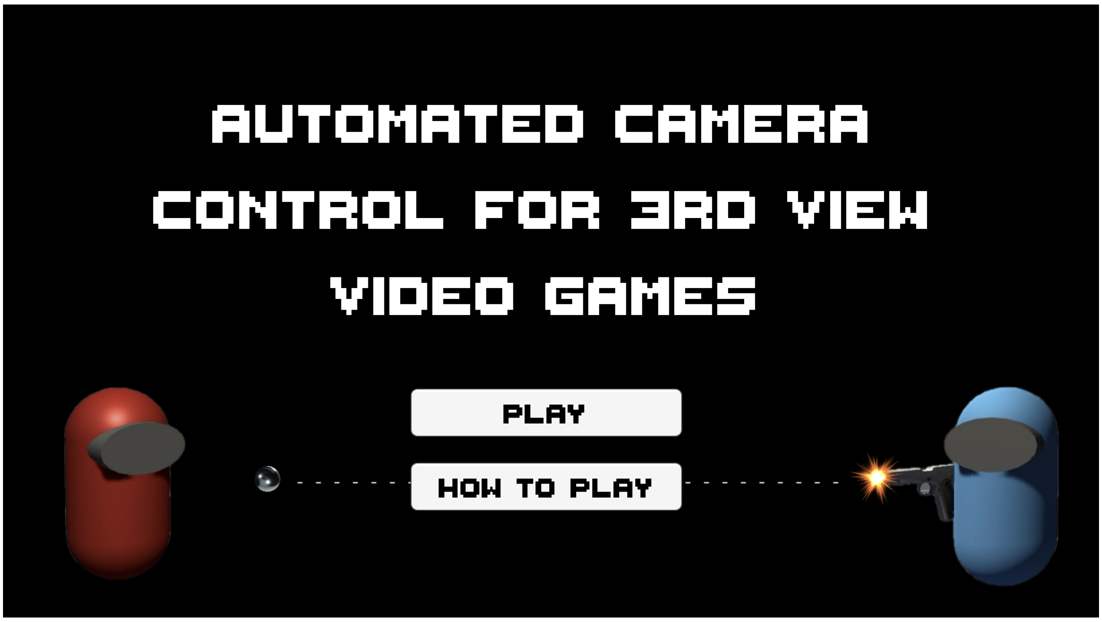

Figure 3.5: Main Menu screen.

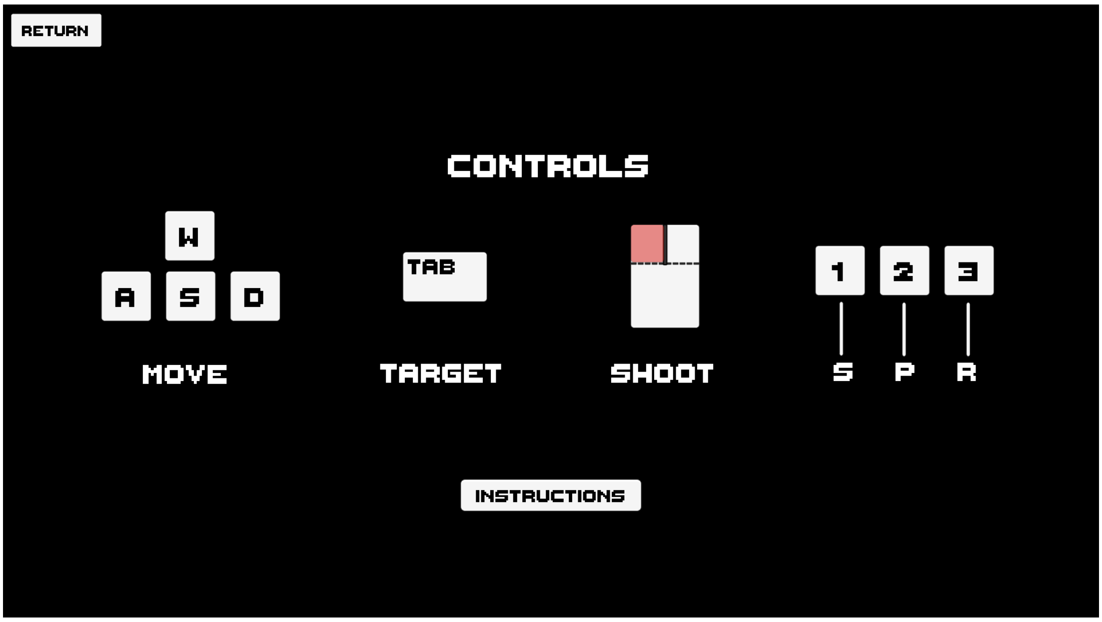

Figure 3.6: Controls explanation screen.

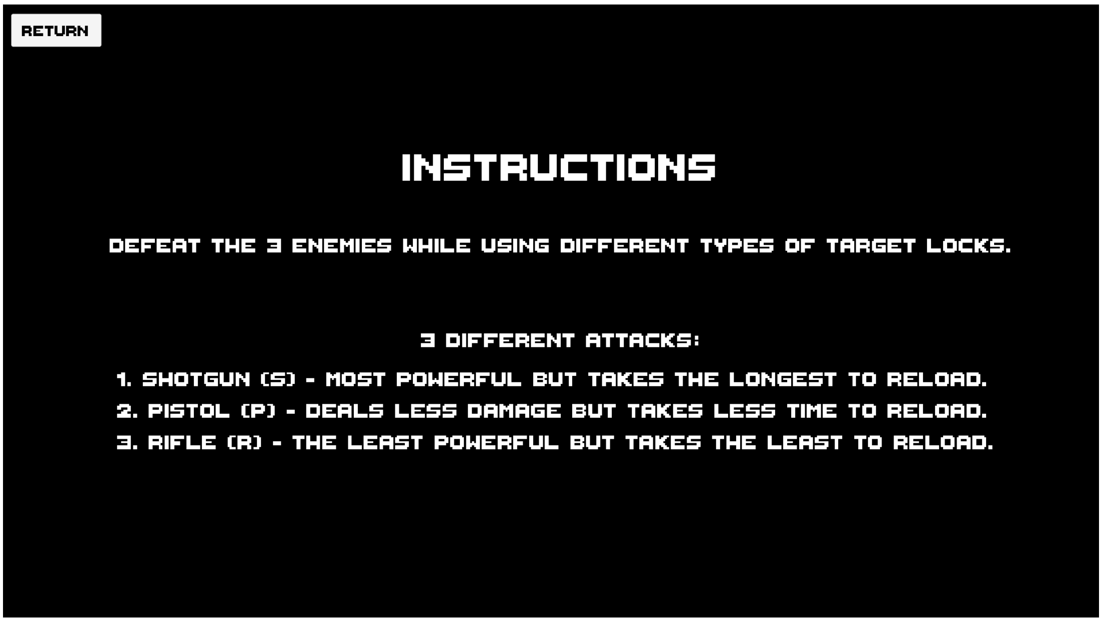

Figure 3.7: Game instructions screen.

Figure 3.8: Transition example screen. The remaining transitions can be found in Appendix A.

Chapter 4

Target-Locking and its Evaluation

Target-locking aims to enhance players' experience by assisting them during fights. Although the existing implementation seen in video games is effective against individual enemies, it produces frustration when facing multiple adversaries. Given the absence of research on alternative locking systems, there is no baseline for new locking systems we could follow. As a result, we created and implemented four new systems in addition to the conventional distance locking, allowing participants to compare their performance directly and decide which one better adapts to their play style. The new target-locking techniques, which have not been seen in video games yet, will consider different features in a battle, aiming to address the frustration challenge.

4.1 General Target-Locking Mechanics

In the game implemented, players can activate the target-locking by pressing the `TAB` key. This will disable manual camera control done via the mouse to focus on the target selected. Consequently, the player can solely concentrate on choosing the attacks and manoeuvring their character, relieving them from further controls.

To guarantee a seamless experience, only those enemies the players encounter within their field of view will be considered. This way, abrupt camera movements will be prevented, which can cause kinetosis (Stoffregen et al., 2008), commonly known as motion sickness. The selected target will be centred on the screen and accompanied by an icon on its main body to show the player which enemy is selected. If the enemy is eliminated, the target-locking system will be disabled, and the camera will be picked up from the same angle it had before disabling it. This will allow players to reassess the environment before reactivating it again.

4.2 Third-View Camera Setting

Before exploring the target-locking systems, we have to understand the mechanics of the camera itself. To provide the third-person camera experience, we used the CinemachineFreeLook component, which is part of Unity's Cinemachine package (cin, 2022). It consists of a virtual camera that automatically moves with and aims towards a selected game object, in this case, the main player. This allows the camera to orbit around the main player along a position specified by three camera rigs.

When the target-locking system is activated, the input the Cinemachine camera receives for the x and y axis is disabled, which corresponds to the mouse movement. Once the selected target is eliminated or the player manually disables the locking system, the camera will get the input from the mouse again.

With this general understanding of the third-person camera, as well as the locking mechanics, we can study the five target-locking systems we implemented and tested.

4.3 Distance Target-Locking

Many video games employ the standard locking system, where the camera follows the target nearest to the player (Bateman et al., 2011). We were also required to implement it to evaluate its performance against our alternative models. As a result, players will be able to give their insights on its advantages and disadvantages and why other systems may or may not be a better choice.

In Figure 4.1, we present a flowchart describing the high-level functionality of the system implemented. As observed, it will only focus on the enemies that are in the current frame. Upon the detection of all visible targets, we calculate the straight-line distance between the player and the target using the Euclidean distance in a three-dimensional space, given by (4.1), and select the closest one.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}. \tag{4.1}$$

In this standard approach, the target will not be updated when another enemy becomes closer to the player. Consequently, the player will have to toggle the camera locking to update the closest enemy.

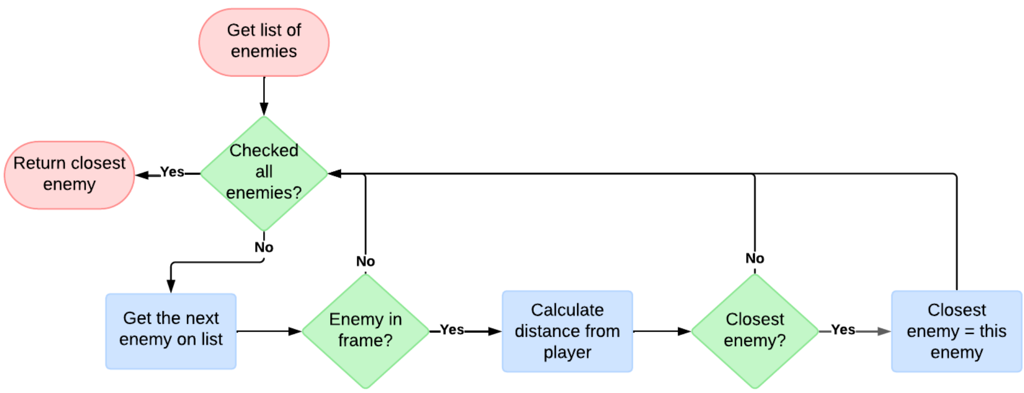

Figure 4.1: Functionality of distance target-locking. If enemies are in the frame when activated, it iterates over them and finds the closest one to the player.

4.4 Health-Based Target-Locking

A health-based target-locking system prioritises the weakest adversary by selecting the enemy with the lowest health. This design will give the player a tactical advantage, potentially reducing the number of threats more efficiently. As a result, the damage received will come from fewer enemies, as those with the lowest health will be quickly mitigated.

The implementation closely follows the system outlined in the previous section. After detecting the enemies in the current frame, we iterate between them and select the one with the lowest health. Similar to the standard system, it will not dynamically change targets if a weaker enemy enters the frame. This design choice could give players more flexibility during the gameplay, as they will have to provide tactical choices during the fight. For instance, the long-distance enemy has the lowest health and will be selected if the system is activated from the start of the game. Nonetheless, players could decide to strategically move the camera to avoid this enemy before activating target-locking in order to eliminate others first.

4.5 Threat-Based Target-Locking

The threat-based target-locking system will select the enemy that has inflicted the most damage on the player. In the case where multiple adversaries have dealt an equal amount of maximum damage, the system will prioritise the one with the most lethal attack. With this design choice, we emphasise the importance of considering both the quantity and power of enemy attacks.

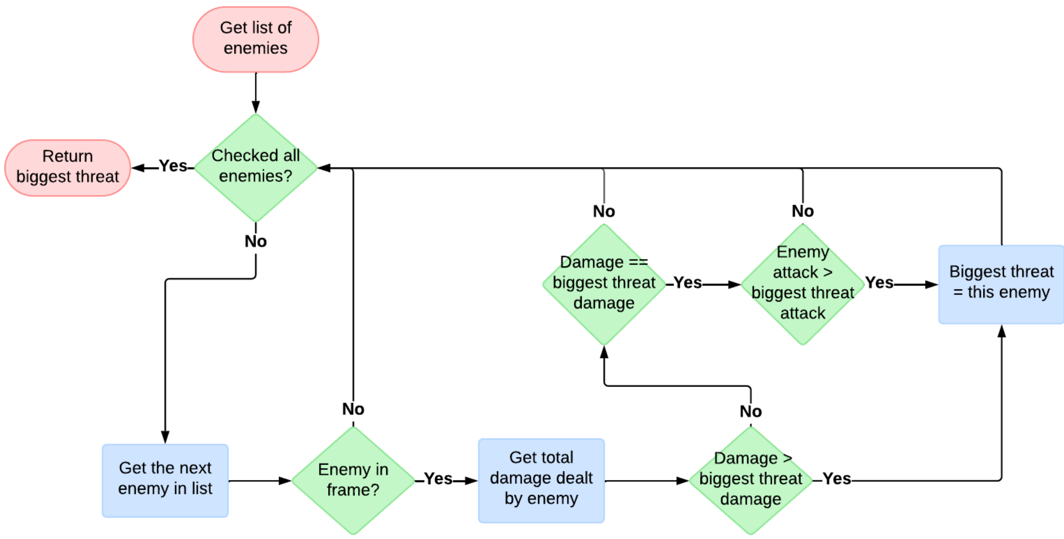

Figure 4.2: Functionality of threat-based locking, where it iterates over all enemies in every frame, continuously searching for the biggest threat.

We developed a damage manager script to implement the system, which tracks the enemy bullets that collide with the player. It will then keep a cumulative record of the damage inflicted by each enemy, which is then used to identify the most prominent threat during locking.

As seen in Figure 4.2, which shows the high-level functionality of this system, the damage manager is called on every frame during the gameplay. This introduces a dynamic approach, which will move from the current target selected if another enemy has dealt more damage. The dynamic nature of this targeting technique implies a constantly evolving combat flow. The fact that the targeted enemy may change requires players to adapt their strategies in real-time, adding unpredictability and excitement to the gameplay.

4.6 Weapon-Based Target-Locking

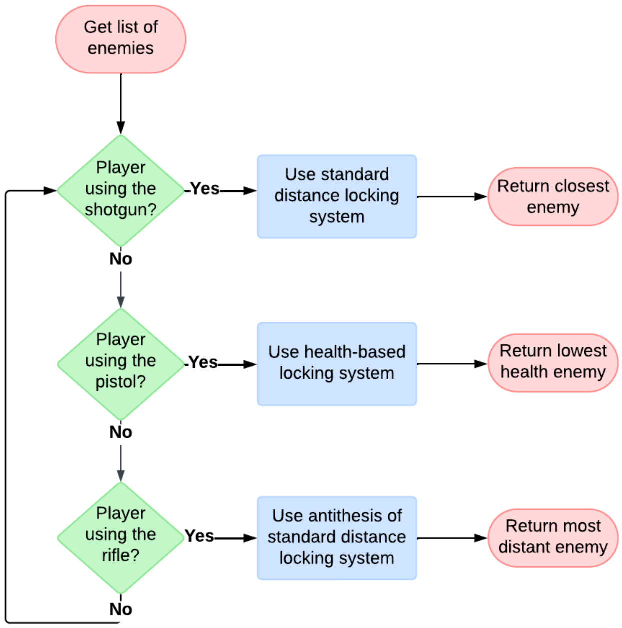

Figure 4.3: Functionality of weapon-based locking. For reference, the complete explanations for the standard and health-based systems can be found in Sections 4.3 and 4.4, respectively. The antithesis of the standard system uses the same implementation as the distance locking, but chooses the most distant enemy instead.

We designed the weapon-based target-locking system to choose the target most vulnerable to the weapon the player is currently carrying. After checking which enemies are in the current frame, the algorithm detects the weapon that is currently active:

1. *Shotgun*: The enemy closest to the player will be selected. Although it is the most powerful at close range, it loses force and speed over longer distances. Consequently, prioritising the closest enemy will provide maximum vulnerability and impact.

2. *Rifle*: The enemy furthest away from the player will be selected. By targeting distant enemies, the strengths of the rifle will be enforced. Even though it has

moderate damage, it is compensated by fast reloading and bullet speed, reaching long-distance enemies faster and more precisely.

3. *Pistol*: Consists of the health-based target-locking system. This weapon is a middle ground between the shotgun and rifle and aims for the enemy that can be eliminated most efficiently, thus selecting the enemy with the lowest health.

As seen in 4.3, it integrates features of previous locking systems. It may be the case that using one single system and focusing solely on a single feature might not prove effective. This way, we will be able to evaluate if using multiple techniques simultaneously could be the way to deal with numerous enemies. This design will also allow focusing on different enemies without the need for real-time strategic considerations, which can lead to the frustration of more inexperienced players. Consequently, the player will not have to toggle the tabulator in order to change between targets, adapting a dynamic locking approach. It will be done automatically; when the locking is activated, the target will change when the weapon is replaced.

4.7 Distance-Switching Target-Locking

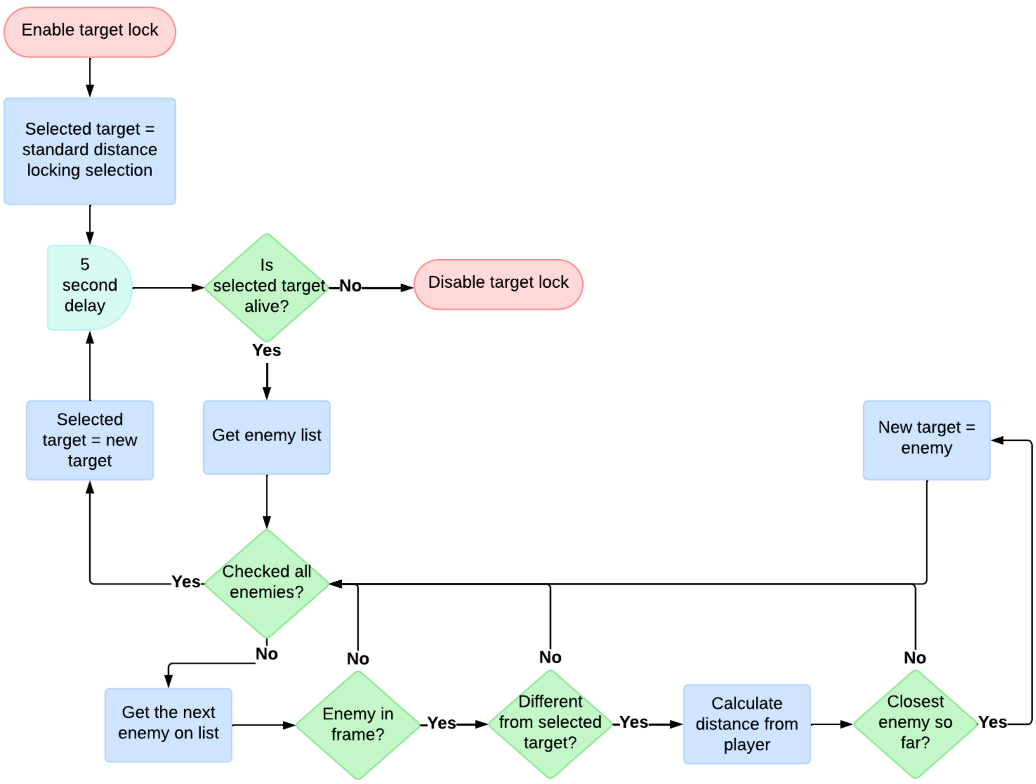

Figure 4.4: Functionality of distance-switch locking. Once activated, and if there are any adversaries in the frame, it will iterate over all enemies and select the closest one, as described in Section 4.3, it then switches to the next closest after five seconds if still alive.

A distance-switching target-locking extends the conventional target procedure described in Section 4.3. Initially, it will select the nearest enemy. However, it will switch to the next closest target if the former remains alive after five seconds, as depicted in Figure 4.4, which describes the overall functionality.

Existing games have not implemented an automatic locking system that involves a dynamic combat flow. Therefore, our goal is to discover whether players would be interested in such a system, depending on their gaming experience. Focusing on a single enemy allows the others to continue their attacks without being damaged. Having the ability to switch between the targets offers a more balanced damage distribution system and, potentially, more efficient eliminations.

In contrast to the weapon-based locking system, which limits weapon choice to a specific target, this system allows players to choose their attack based on the targeted enemy. This provides greater freedom for experienced players who seek a more significant say during a combat scene. We aim to discover player preferences and potentially find a consensus among different opinions.

4.8 Evaluation

Solely implementing different target-locking systems and having participants play will not give us relevant information to determine if other systems are more effective and enjoyable, leading to less frustration.

Our initial strategy to gain objective results involved implementing a player AI capable of using all systems. The plan was to evaluate the performance in each scene and find the most effective target-locking feature. However, we found this procedure impractical since the AI did not manifest human-like movements and could not dodge enemy attacks. As a result, the strategy the player AI had of aiming at the target did not give valuable results and forced us to substitute the strategy. This involved an approach where we would gather both qualitative and quantitative data, ensuring a more meaningful analysis.

4.8.1 Qualitative Data

We need to understand the impressions and opinions of each player on the implemented systems. The main goal is to find a target-locking approach that outperforms the current one in performance but also alleviates player frustration – a growing concern within the community regarding targeting systems. As a result, we asked the following questions to all participants after completing the game:

1. Do you have experience with video games? Which kind?
2. Which type of target-lock did you find most effective for your play style? Why?
3. Did you come to rely on the target-locks during the different scenes?
4. Were there any challenges or frustrations you encountered while using a specific target-lock?

5. Did you think that a dynamic target-locking system positively contributed to your experience?

6. Does using a target-lock (in general) lead to less frustration?

7. Do you think that distance target-locking is too basic for games nowadays?

8. Are there any improvements you would suggest for another targeting system?

These questions allow us to understand each player's skills and which target-locking method they felt more comfortable with. We aim to understand whether their past experience influences their preferred system and whether they aim to gain more or less control during combat. As a consequence, we will learn whether the standard system is indeed too simple for games nowadays, and if new systems that implement dynamic mechanics alleviate the player's concerns.

4.8.2 Quantitative Data

In addition to the subjective feedback, we must measure the players' performance through an impartial mechanism. This is done through quantitative data, which involves extracting outcomes and information directly from the gameplay, allowing us to analyse the different rounds objectively.

To collect this data, we included a `Scene Analyser` script into each scene, allowing the recording of relevant details every second. This includes tracking the damage inflicted by each enemy and the player, as well as their respective health levels. By analysing this information, we can reveal with which locking system the player dealt the most damage, survived the longest, and helped mitigate the enemies more efficiently. After the game concludes, a database in the form of a `CSV` file is generated, enabling the analysis. Figure 4.5 shows an example of the generated file.

Character	Health	Total Damage Done	Time
Player	100	0	0
Enemy 1	50	0	0
Enemy 2	40	0	0
Enemy 3	20	0	0
Player	100	20	1
Enemy 1	50	0	1
Enemy 2	20	0	1

Figure 4.5: Partial table from CSV file, showing relevant data after one second of the fight scene.

Chapter 5

Data Analysis and Results

The experiment seeks to analyse the behaviour of different users interacting with the video game and discover whether the distance locking system is too simple and underperforming. Our aim is to find out if selecting a target based on other features gives better results, by analysing the actual data extracted from the scene and subjective feedback. Consequently, we gathered various participants with different video game experiences to find a consensus.

5.1 Experimental Design

5.1.1 Participants

We recruited 18 undergraduate students to serve as test subjects for the video game. Based on their prior gaming experience, we classified them as follows:

1. *Novice players*: They have little to no experience, allowing us to see the results for a non-biased person who does not have preconceived notions of how different targeting systems have worked in the past.
2. *Casual players*: They have some experience with video games, either on PC or other consoles, allowing us to get feedback on a more theoretical level from someone familiar with games.
3. *Expert players*: They have extensive experience with video games and have been playing for a long time. This will allow us to get highly critical comments on the systems and a comparison with the target-locks they have used in the past.

The different skill levels allowed us to gather a wide range of impressions, expectations and experiences. In our study, three identified themselves as novice players, six as casual players and nine as experts. After providing consent, they participated in the experiment, which took an average of 20 minutes to complete.

5.1.2 Procedure

Each experiment was done individually for each participant to avoid biased opinions. We aimed for a dynamic study where we could ask questions on the go to get their live impressions of the system. Consequently, it was carried out in person, allowing us to use our device to play the implemented game and access the quantitative files directly after it ended.

The study's motivation was explained to the participant when beginning the experiment. After they were made aware of what a target-locking system was, we explained the structure of the overall study, which we split into five blocks, one for each target-lock and a pause between each. Here, we asked for their impressions of the specific locking system they just used. This way, we made sure they were gathering their thoughts along the way to get a robust conclusion once it finished. When the game ended, we would ask the questions provided in Section 4.8.1, giving their overall feelings and new potential suggestions.

5.2 Qualitative Results

First, we analysed the questionnaire answers and the participants' overall impressions of the target-locking systems. We then examined the results for each individual to better identify a pattern before combining the results of the 18 participants.

5.2.1 Novice Players

All three players emphasised that they entirely relied on the target-locking systems to advance in the scenes, corroborating its importance for video game beginners. The players described that it was difficult to move and aim simultaneously, and this helped them advance. A participant mentioned that aiming itself was already challenging enough, and this tool allowed them to move forward.

The players were unaware that a dynamic targeting system was not seen in other games and thought it could contribute to the gameplay. Two participants mentioned they were focused on a single enemy and forgot about the existence of the others. Having it switch to the others based on the weapon, time, or threat allowed them to increase their awareness.

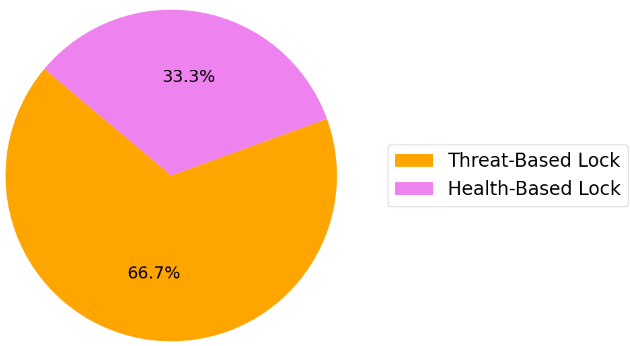

Figure 5.1: Preferred locking systems distribution for novice players.

In Figure 5.1, we observe the overall preferred systems among the five implemented. By doing a further analysis, we can understand the reasoning behind the selection:

- **Distance Target-Locking:** All novice participants thought the standard distance locking was too basic for their needs, as they preferred a more interactive system. They especially felt frustration when long-distance enemies were dealing damage, and they could not focus on them because there were targets on the way.
- **Health-Based Target-Locking:** It was the preferred approach for one participant, as they felt it was the most intuitive, allowing them to kill their enemies faster.
- **Threat-Based Target-Locking:** Two of the three novice players thought the threat-based target-lock adapted better to their playing style. They believed it was the most intuitive system and felt they were advancing more by eliminating the enemy that was hitting them the most. It felt more engaging, especially since they did not know which enemy dealt more damage, giving them more helpful information than the other systems and producing more satisfaction.
- **Weapon-Based Target-Locking:** Two participants believed the weapon-based method was a good idea in theory, but in practice, it was difficult to manage since they had to consider too many things simultaneously.
- **Distance-Switch Target-Locking:** There was a consensus on the distance-switch lock, as they found it confusing that it changed target after five seconds. They did not understand what was happening and took time to adjust.

Even though they all found the health and threat-based systems more functional, they thought others were too complicated to understand from one scene alone. However, the standard system clearly lacks effectiveness and sophistication in comparison with the preferred alternatives. Overall, players emphasised the importance of intuitive and engaging target-locking systems for smoother gameplay progression and a better experience.

5.2.2 Casual Players

Of the six casual players, all stated that they relied on the target-locking systems in general, meaning that it is a tool that is useful not only for beginners. These participants noticed that dynamic target-locking was a new feature and saw its potential, thinking many games would benefit from its use. A participant believed it would generate much less frustration, especially for beginners, since it allowed them to disconnect from thinking about other enemies and focus on other parts of the game.

Figure 5.2 provides insights into the participants' favourite systems, nevertheless, a deeper examination is needed:

- **Distance Target-Locking:** One participant considered it as the most intuitive and helpful, expressing that they are used to playing with this system and liked to focus on the closest target. They generally liked to focus on a single enemy at a time and did not enjoy switching them until they eliminated it. Nonetheless, the remaining five participants thought the distance-based lock was too simple, giving feedback similar to Section 5.2.1.

- **Health-Based Target-Locking:** The general feedback stated that in some particular scenarios, it generated some frustration. The enemy that was the furthest away was sometimes the one that had the lowest health, therefore, when they had enemies nearby that created more damage, the players felt more annoyance.
- **Threat-Based Target-Locking:** It is the winning system in this category. Three of the six participants thought it was the most intuitive idea and liked to prioritise the enemy that was damaging them the most.
- **Weapon-Based Target-Locking:** Two participants thought the weapon-based approach was helping them to a greater extent; even stating that it encouraged them to use the other weapons and use them to their advantage.
- **Distance-Switch Target-Locking:** This system was criticised the most among the implemented methods because of the loss of control during the round. Nonetheless, it received several good comments as some participants thought it helpful to distribute the damage and not focus on one target at a time.

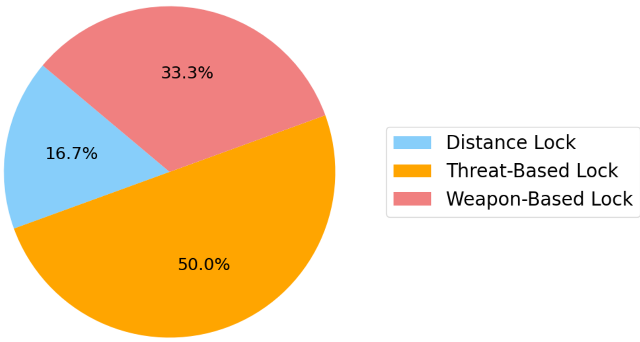

Figure 5.2: Preferred locking systems distribution for casual players.

All participants concluded that the use of a target-locking system generally caused less frustration, allowing them to be more precise and kill their enemies faster. Since the majority of participants thought the standard approach was overly simplistic, it highlights the importance of introducing new systems. This is especially true when integrating a dynamic mechanism, which five of the six participants thought contributed to their gaming experience.

5.2.3 Expert Players

The nine expert players were accustomed to the game mechanics but still thought they relied on the target-locking system to some extent. Several participants stated that against targets at greater distances, they could deal more damage, which would not have been possible without the locking activation.

All participants appreciated the use of the dynamic targeting approach. Two explicitly mentioned that they never used the standard locking system due to its primitiveness. A dynamic one would better adapt to their gameplay and make them want to activate it since it would generate less frustration.

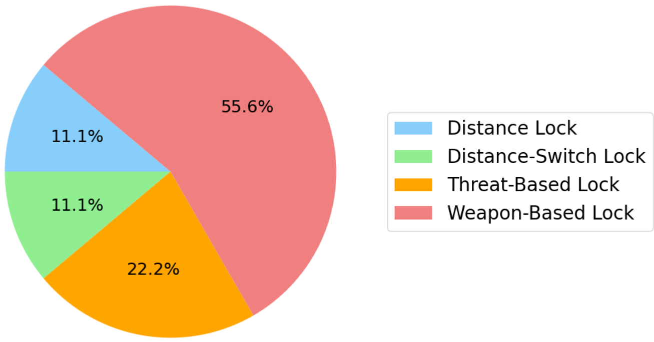

Figure 5.3: Preferred locking systems distribution for expert players.

In Figure 5.3, we see the overall preferred systems among the five implemented again, but for experienced players. We can understand the reasoning behind the selection by doing a further analysis:

- **Distance Target-Locking:** One participant preferred the standard system due to its intuitiveness, as it is the one they had previously used in other games. However, the eight remaining participants considered it very basic, especially when used in the games they currently play.
- **Health-Based Target-Locking:** This was the most criticised technique because even though the enemy with the lowest health was not dealing damage to them, it was still selected.
- **Threat-Based Target-Locking:** Two participants thought it contributed more to their fighting style than the other implementations. They explicitly liked knowing which enemy was dealing the most damage since this was information they could use to win the fight more efficiently.
- **Weapon-Based Target-Locking:** It is the preferred method overall, with five out of the nine thinking it was an intriguing approach for a locking system since it allowed them to use each weapon's advantages and change them throughout the scene. It also gave them more control within the gameplay, as they could change enemies depending on the weapon they were currently wearing.
- **Distance-Switch Target-Locking:** Although novice and casual players thoroughly criticised this system, experts adapted to it better and gave positive feedback. Most of them commented that it would be a worthwhile tool, especially if more control were added to it. One participant voted it as their favourite, as it gave more versatility to that player and allowed them to enjoy the scene more.

As all players acknowledged the usefulness of a dynamic mechanism, it is coherent that the weapon-based system, which is most participants' favourite, used this methodology. Thus, it is noticeable that most critics were about static methods like the standard distance and health-based systems.

5.2.4 Overall Results

From analysing the feedback given by all players, we see that a different targeting system is preferred depending on their skill level. Novice and casual players generally thought the threat-based approach suited them better and gave a better impression. Nonetheless, the majority of the expert participants preferred weapon-based locking.

The expert participants noted that it gave them more control and liberty when fighting, which is something the standard lock lacks. On the other hand, the rest of the players who did not have such experience preferred a target-lock that decided for them whom to attack, and the threat-based system achieved this goal while also selecting an enemy they thought was worth attacking.

While combining all the preferred systems, we get Figure 5.4, where it is clear that the weapon-based and the threat-based approaches were the favourites overall. Although other participants voted other systems as their best pick, it is clear that the distance was not among the favourites, implying that it is indeed too simplistic.

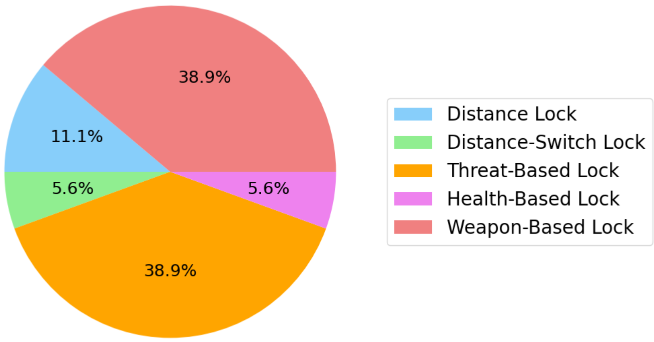

Figure 5.4: Preferred locking systems distribution among players of all categories.

5.3 Quantitative Results

The feedback directly given by the players gave meaningful insights into how each system affected their frustration and their overall experience. Nonetheless, it is also interesting to examine the objective data, where we can analyse which design allowed them to eliminate all enemies faster or which generally extended their survival. This entails looking at the health of each player over time, as well as the damage they deal to the enemies.

5.3.1 Novice Players

In Figure 5.5, we used the data extracted from the `Scene Analyser` to plot the performance of the five distinct target-locking systems. The left side of the figure displays the average health of the novice players every second of the fight over a period of over 50 seconds, while the right side represents the accumulated average damage inflicted by the player per second. These averages were normalised by the number of surviving players at each time interval, allowing us to observe more explicit performance patterns.

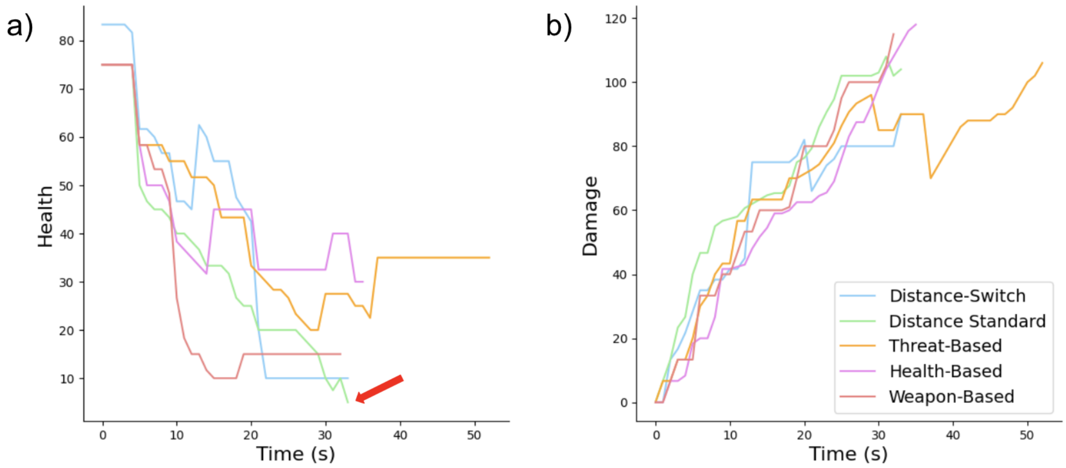

Figure 5.5: a) displays the average health for novice players throughout time, highlighting the lowest health achieved with a red arrow. b) shows the average damage done by the players every second, for every locking system.

In Figure 5.5a), we can analyse in detail the health trends for each target-locking system. The weapon-based and distance-switch systems show the steepest decline in health, which matches the qualitative feedback, where participants described it as overwhelming since it made them focus on various things simultaneously. Yet, the lowest average health was achieved with the standard method as indicated with a red arrow. With this lock, the participants' health decreased consistently, indicating that novices found it difficult to maintain their health with this approach. Conversely, the threat-based and health-based systems showed more favourable outcomes when preserving health, which also matches the qualitative feedback, as they were both mentioned as the preferred techniques. They led to better overall performance in health maintenance, reaching a higher health level when the round finished.

Moving to the analysis of the average damage output depicted in Figure 5.5b), we observe that all systems follow a similar increasing pattern, where the health-based approach achieved the highest peak, closely followed by the weapon-based target-lock. The standard method does not lag far behind, showing that it is capable of dealing damage even though it can affect the player's health. The threat-based system generally achieves the most consistent results with a higher final health and damage average. This matches the decision of the majority of novices to vote for this approach as their favourite.

The longevity of the gameplay using the threat-based system is worth noting, as it reaches the 50 second-mark while the others do not go past 40 seconds of duration. When analysing each player's relevant data, we noticed that it was the only method that allowed the three participants to complete the round by eliminating all targets, reinforcing the idea that a threat-based locking system is best for novice players. For the remaining procedures, at least two players were unable to finish the round, except for the health-based approach, where two players did complete it.

5.3.2 Casual Players

In Figure 5.6, we also observe the players' health and damage performance for different locking systems but for casual participants. From 5.6a), we can see that the standard system resulted in the lowest average health by the end of the round and the shortest survival time, as indicated by the red arrow. Detailed examination of individual player data reveals that this approach obtained the highest mortality rate, with only two out of the six players succeeding in eliminating all enemies. The health-based and distance-switch systems have slightly higher final health averages but do not make a significant difference. In contrast, the weapon-based battles were the most prolonged, with five out of the six participants successfully completing their rounds. However, the threat-based technique obtained the highest average health at the end of the fight, with all players eliminating the enemies, indicating its effectiveness in sustaining player health while achieving the goal of enemy elimination.

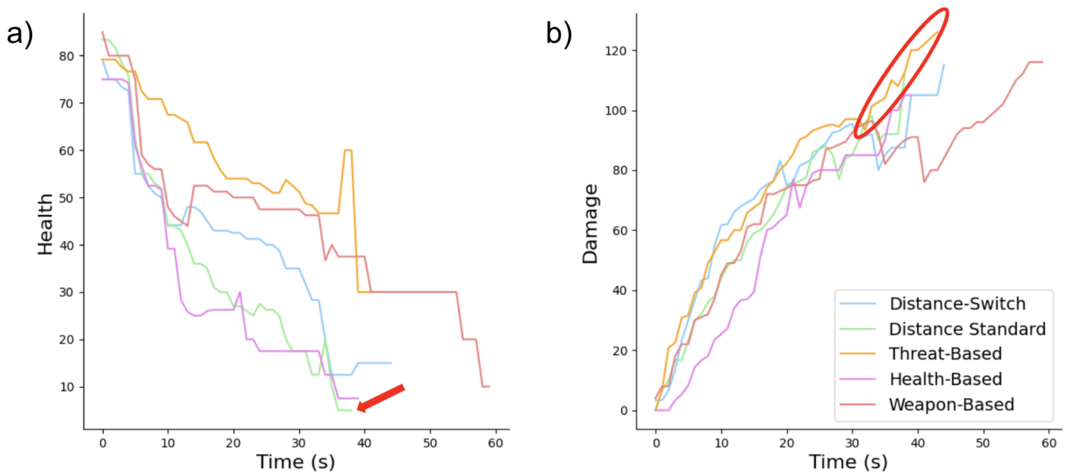

Figure 5.6: a) displays the average health for casual players throughout time, highlighting the lowest health achieved with a red arrow. b) shows the average damage done by the players every second, accentuating a steep increase in damage for the threat-based system with a red oval shape.

In the analysis of the damage output by each system in Figure 5.6b), we observe that during the initial 30 seconds, there is a similar increasing pattern for each of the target-locking methods. The threat-based system, however, contains a steeper and more consistent incline from that point, reaching the highest peak in damage overall, circled in red in the figure. The weapon-based approach secures the second-highest peak past the 60-second threshold. The remaining systems have comparable performances regarding the damage capabilities, with the distance-switch achieving a slightly higher overall result.

By exploring each individual casual player file, we can uncover which target-lock allowed the elimination of all enemies. The only system that resulted in the survival of all participants was the threat-based, echoing the choice of the 50% of players who favoured it. Two techniques stood out for the highest mortality rate: the standard distance locking and the health-based systems. This aligns with the player's feedback since, overall, they believed the standard approach was too simple for their needs, while the health-based generated general frustrations, as described in Section 5.2.2.

5.3.3 Expert Players

In Figure 5.7, we highlight again the impact of the systems on the players' health and damage output but for expert players, whose battles extend beyond 80 seconds. In terms of the players' health, as seen on the left side of the figure, the standard system reached its own lowest health the fastest after a very steep decline in the second 40, indicated with a red circle. Even though the weapon-based system reached the lowest average, all the players managed to complete the round and eliminate all enemies, which is also the case with the distance-switch approach.

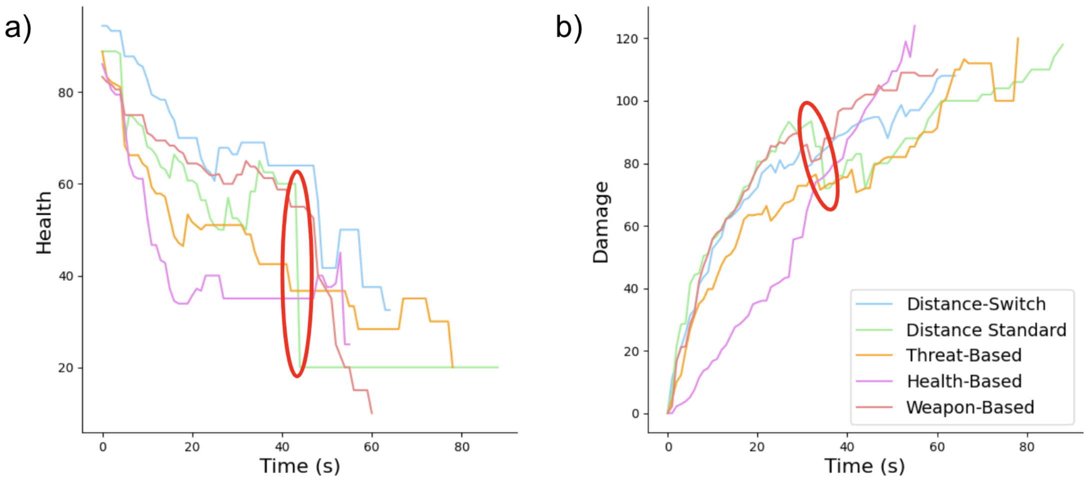

Figure 5.7: a) displays the average health for novice players throughout time, highlighting an abrupt decline in health for the standard system with a red oval. b) shows the average damage done by the players every second, emphasising a drop in damage for the standard system.

When analysing the accumulated damage dealt to the enemies over time in 5.7b), we can also make a direct comparison with the health output. The weapon-based lock shows the most consistent damage output. All methods generally have an increasing pattern, except for the standard locking method, which has a more significant drop in damage, shown in red. This can be explained by the fact that various players died at that point, reducing the average. The greatest damage was done with the health-based system, followed by the threat-based lock, which has consistently been in the top three within the three-player categories.

When comparing both graphs, the threat-based approach offers a more balanced approach to target-locking since it still produces high damage outputs while preserving the player's health.

5.3.4 Overall Results

From all locking systems, the threat-based obtained the best results among all player categories, with consistent health and damage performances. Even though the weapon-based proved challenging for novices, it was useful for casual players and performed exceptionally well for expert participants. Similarly, the distance-switch system was perceived as confusing for infrequent players but showed potential for those who had more experience. The decline in health for casual and novice players was steeper than for experts, which could be produced from unfamiliarity with game mechanics, leading to more mistakes and damage received.

We observe that, overall, players performed better when using dynamic systems. The static target-locking approaches did not stand out among the rest, even giving poor results.

Chapter 6

Discussion

6.1 Overall Outcomes

By analysing the qualitative and quantitative data, we can determine that dynamic locking techniques, specifically weapon-based and threat-based systems, provided effectiveness and player satisfaction. Novice and casual participants enjoyed the use of the threat-based approach the most, as they stated that knowing the biggest threat was a helpful feature in a fight. This was also reflected in the quantitative data, where both categories successfully completed their round with the threat-based system and obtained constant results regarding health and damage dealt to the enemies.

The experienced participants preferred the weapon-based system by a significant margin, showing they could deal with more complexity. They were the only category in which all players completed the round, managing to consistently deal damage throughout the game. Nonetheless, it is important to note that they survived not only with the distance-switch but also with the threat-based system, showing that it is effective among players with diverse skills.

Thus, both winning approaches show that players appreciate adaptability in locking systems and context awareness. These features support them during decision-making moments in real-time, meaning that the introduction of a dynamic mechanism can alleviate frustration.

There was a general decision to describe the standard system as too simple, not aiding them but frustrating them during the fights. We can attest to this in the quantitative results since, for all categories, it did not stand out and even gave poor results, especially regarding the player's health. This corroborates our hypothesis that video games nowadays need to take more features into consideration when selecting a target and that taking solely the closest one is insufficient. Dynamic systems allow the selection to adapt to varying situations, therefore, being more responsive.

6.2 Limitations

When evaluating the effectiveness of different target-locking techniques in a gaming context, the environment itself can significantly influence the player's experience and results. For this study, we used a basic environment lacking objects or different altitudes the players could use to their advantage. Real-world video games often use complex arenas, potentially affecting the results of the target-locking systems since some enemies could be hidden behind objects. Consequently, our results may not fully capture how the systems work in typical gaming conditions. While this study provides preliminary insights, its findings need to be tested in a more representative game since alleviating frustration in a basic environment does not imply it will be relieved in a more complex setting.

In terms of the in-game experience, our study was limited to a scenario with only three adversaries, which might not have tested the locking systems to their full potential. Video games count multiple enemies with various abilities and features; therefore, testing the target-locks with an increased number of enemies with diverse threat levels could have provided richer and more relevant results. The scope of the player's abilities was also reduced in contrast to commercial video games, which offer a range of attacks and abilities. This could affect the dynamics of the locking systems and the gameplay, as different strategies could be used.

Furthermore, our study's participant pool was limited to 18 participants, which may not be indicative of a broader player population. Our set consisted of undergraduate students of similar ages. Having participants of different age groups, skill levels and preferences could affect how they interact with the locking systems and how they perceive the results. Therefore, a more extensive and varied base could produce more generalisable results to help us understand whether there is a preferred approach overall.

A limitation that does not consider the implementation itself is our exclusivity to the PC platform. Console gaming constitutes a significant portion of the video game market (Babb et al., 2013), with a different set of challenges and experiences due to its unique control scheme. Controllers are frequently used for console gaming, which could impact how players interact with the locking systems and other game mechanics. By expanding our testing to include console platforms, we could provide a more comprehensive understanding of how target-locking systems perform in different gaming ecosystems.

6.3 Future Work

Given the current limitations, we can overcome them by expanding and implementing the project in a real game such as *Dark Souls*, where players have complained about the target-locking design. This will also expose our new approaches to more complex situations, testing them in different environments and with enemies that have different abilities and actions.

Refinements can also be made to the systems themselves, given the player's feedback:

- **Enhance weapon-based system**. Choosing the most vulnerable target to the current weapon gave good results. However, it should consider the range of each weapon. For instance, the pistol selected the enemy with the lowest health; however, if the enemy were too far away, the bullet would not reach. Thus, another enemy should be selected. This system could also take into consideration whether enemies are one shot away from being eliminated. Consequently, if the current weapon is capable of eliminating a certain enemy from one hit, that target should be prioritised.

- **Combine metrics**. Since the threat-based and weapon-based systems were clearly the most popular among all, a combination of these could produce a good target-locking selection. For instance, begin by choosing the enemy most vulnerable to the current weapon, but if the player's health drops to a certain threshold, switch to the enemy posing the biggest threat.
- **Increase freedom**. Expert players, in particular, missed having more freedom regarding the target selection. Even though an initial target is selected, switching between enemies should be allowed.

Chapter 7

Conclusions

Through our investigation into third-person camera challenges, we uncovered the issues with the automated tool of target-locking, which the industry overlooks. In many popular games, especially RPGs, it is an essential mechanism, especially for those who have just embarked on gaming. However, a significant concern emerges when multiple enemies are in sight, where the conventional target-locking system used in video games will select the nearest target. This results in the player's frustration, as in many cases, the closest enemy is not the best option of all. As a result, players are not able to effectively engage with their enemies, making a more challenging encounter.

To find out whether the standard system could be outperformed, we created and implemented four different locking systems, each of which selected a target based on various game metrics such as enemy health, weapon type, and threat level. To test these approaches, we created a baseline environment with no disturbances in the background so that we could focus solely on the target-locking itself. By having eighteen participants with different sets of skills try out the game, we found out through quantitative and qualitative data whether the new systems had better performance and were more enjoyable overall.

The conclusions showed us that the standard system was indeed too simple and generated frustration. Nonetheless, most participants appreciated a dynamic procedure that automatically adapted the target as the fight developed. This resulted in the threat-based and weapon-based methods being the most popular among the participants. The threat-based approach was considered more intuitive, which explains why it was preferred by those with less video game experience, such as novices and casual players. On the other hand, the weapon-based was considered more complex for novices but was the most popular among the experienced participants, who were familiar with game mechanics and could perform adequately.

Even though the results from eighteen participants do not dictate the norm for all players, these findings serve as a baseline for realising the preferences of gamers with different skills and tastes. They highlighted the importance of a shift from simplistic target-locking systems towards a more dynamic and context-sensitive resolution. As games become more complex, it is crucial to emphasise the importance of creating target-locking systems that are accessible to beginners but also engaging for veterans, which is a need that the standard system is not currently achieving.

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Appendix A

Game Transitions

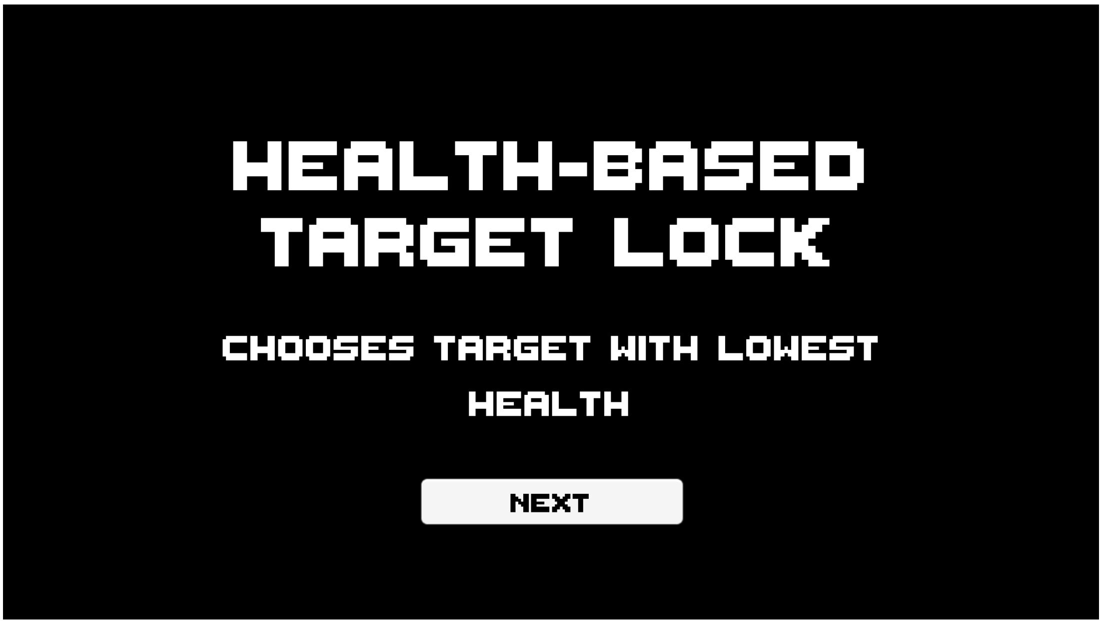

Figure A.1: Transition to the health-based system.

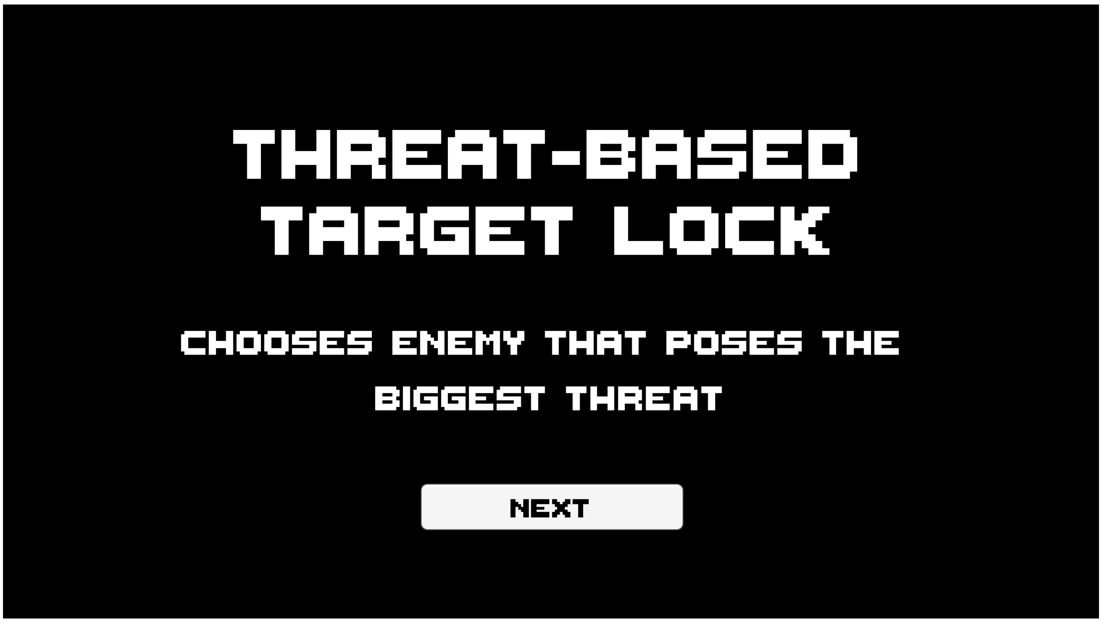

Figure A.2: Transition to the threat-based system.

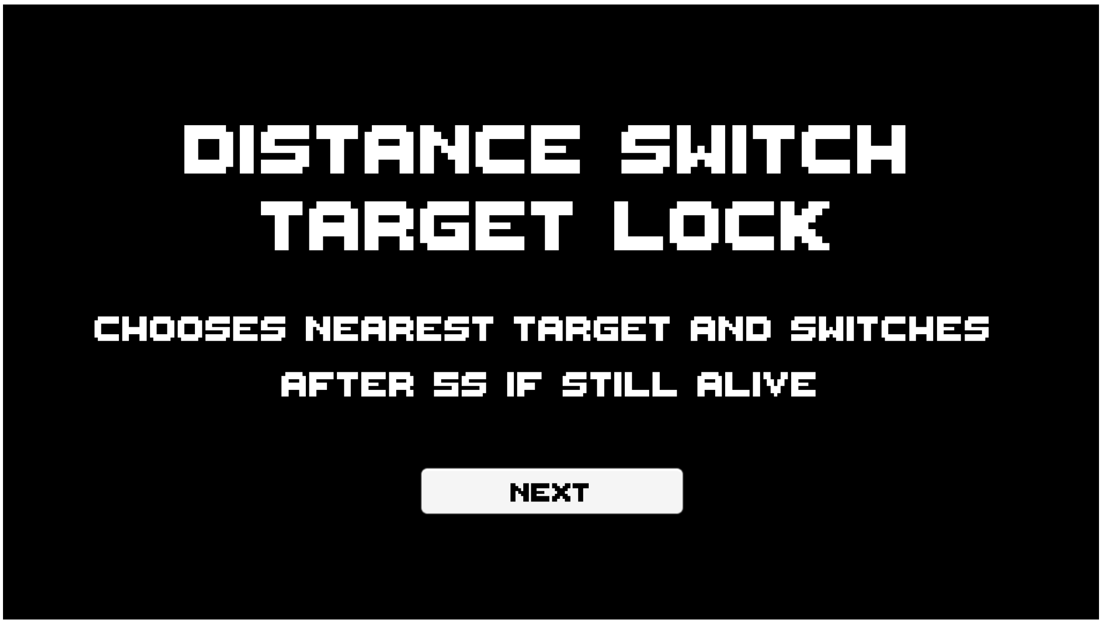

Figure A.3: Transition to the distance-switch system.

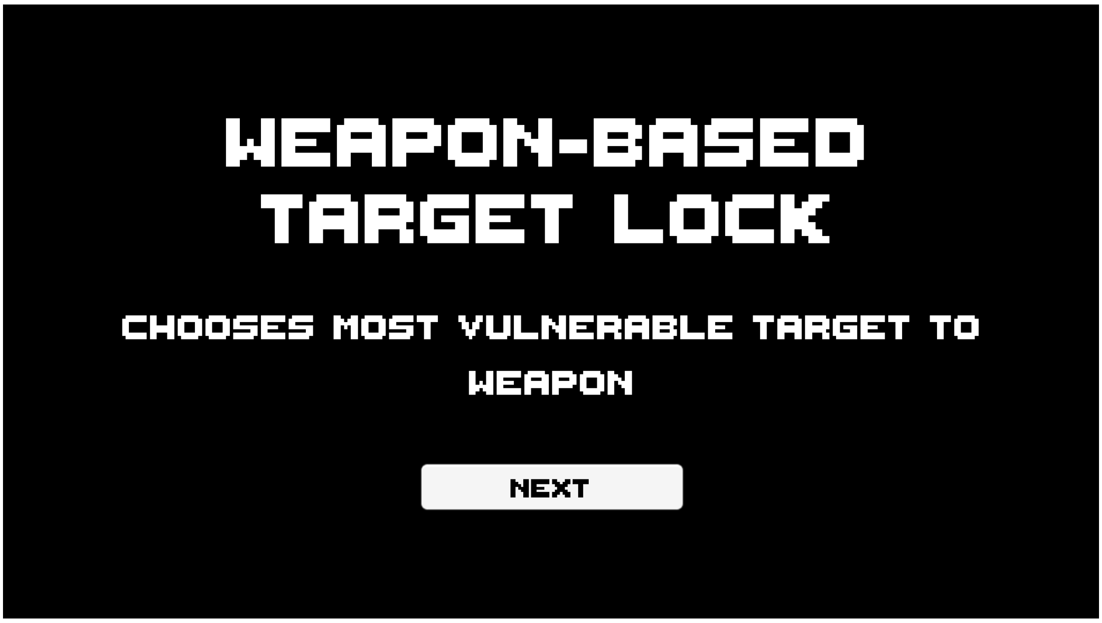

Figure A.4: Transition to the weapon-based system.

Appendix B

Participants' information sheet

Participant Information Sheet

Project title:	Automated Camera Control for 3rd Person Video Games
Principal investigator:	Dr. Steve Tonneau
Researcher collecting data:	Isabel Martinez Barona Garcia
Funder (if applicable):	

This study was certified according to the Informatics Research Ethics Process, reference number 750126 Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Dr. Steve Tonneau and Isabel Martinez Barona Garcia.

What is the purpose of the study?

During fighting scenes in video games, targeting enemies can be a difficult task, especially when multiple of them are encountered.

Six different systems that automatically target the most optimal enemy have been implemented, and the goal is to measure their performance with people that have different experiences with video games.

Why have I been asked to take part?

People with different amounts of experience in gaming are needed, to assess which system works best for every level of experience.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, up until the study is over without giving a reason. After this point, personal data will be deleted and anonymised data will be combined such that it is impossible to remove individual information from the analysis. Your rights will not be affected. If you wish to withdraw, contact the PI. We will keep copies of your original consent, and of your withdrawal request.

Figure B.1: Copy of the Participants' information sheet - Page 1

What will happen if I decide to take part?

When taking part, we will ask your age and experience with video games. You will then try the video game, which consists of a fighting scene with three different enemies.

To assess your performance with each type of target-locking systems, you will have to try the video game with each system, where we will record data only concerning the game. This includes time taken to complete a fight, number of enemies defeated, amount of damage made and received, or whether you could complete the fight.

No other personal information will be needed, so your participation will be completely anonymous.

The session will run for less than an hour and only one session will be needed to complete the study.

Are there any risks associated with taking part?

There are no significant risks associated with participation.

Are there any benefits associated with taking part?

No

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a maximum of 2 years. All potentially identifiable data will be deleted within this timeframe if it has not already been deleted as part of anonymization.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the researcher/research team: Dr. Steve Tonneau and Isabel Martinez Barona Garcia.

Figure B.2: Copy of the Participants' information sheet - Page 2

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?
The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?
If you have any further questions about the study, please contact the lead researcher Isabel Martinez Barona Garcia, i.martinez-barona-garcia@sms.ed.ac.uk.
If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.
If the research project changes in any way, an updated Participant Information Sheet will be made available on http://web.inf.ed.ac.uk/infweb/research/study-updates.

Alternative formats.
To request this document in an alternative format, such as large print or on coloured paper, please contact Isabel Martinez Barona Garcia, , i.martinez-barona-garcia@sms.ed.ac.uk.

General information.
For general information about how we use your data, go to: edin.ac/privacy-research

Figure B.3: Copy of the Participants' information sheet - Page 3

Appendix C

Participants' consent form

Participant Consent Form

Project title:	Automated Camera Control for 3rd View Video Games
Principal investigator (PI):	Dr. Steve Tonneau
Researcher:	Isabel Martinez Barona Garcia
PI contact details:	stonneau@exseed.ed.ac.uk

By participating in the study you agree that:

- I have read and understood the Participant Information Sheet for the above study, that I have had the opportunity to ask questions, and that any questions I had were answered to my satisfaction.
- My participation is voluntary, and that I can withdraw at any time without giving a reason. Withdrawing will not affect any of my rights.
- I consent to my anonymised data being used in academic publications and presentations.
- I understand that my anonymised data will be stored for the duration outlined in the Participant Information Sheet.

Please tick yes or no for each of these statements.

1. I allow my data to be used in future ethically approved research. **Yes** **No**

2. I agree to take part in this study. **Yes** **No**

Name of person giving consent	Date dd/mm/yy	Signature
Name of person taking consent	Date dd/mm/yy	Signature

Figure C.1: Copy of the consent form.